6. On the Geographical Distribution of the Land-Mollusca of the Philippine Islands, and their Relations to the Mollusca of the neighbouring Groups. By the Rev. A. H. Cooke, M.A., F.Z.S., Fellow and Assistant-Tutor of King's College, Cambridge.

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The Land-Mollusca of the Philippines may be regarded as consisting of two classes, those belonging to peculiar genera or subgenera developed after the final separation of the group, and those belonging to genera or subgenera common to the neighbouring islands. These latter may again be subdivided into (1) Indo-Malay and (2) Moluccan and Polynesian genera, according as the metropolis of their development lies to the S.W. or the S.E. of the Philippine group.

The object of the first part of this paper is to examine the distribution of the genus *Cochlostyla* amongst the different islands of the Philippine group. The Philippines are distinguished from every other group throughout the Pacific, except the Sandwich Islands, by the possession of an almost wholly peculiar and very conspicuous genus of Land-Mollusca, of striking beauty in form and ornamentation, and exceedingly rich in species [1]. The genus falls into 15 subgenera, the majority of which are on the whole fairly well marked, although the distinction between several of them is somewhat arbitrary. Not a single island is without its representative of the genus, and the species and even the subgenera are frequently much restricted in the area of their distribution. The whole genus thus forms an interesting clue by which to examine the problem of the ancient relationship of the different islands to one another.

Preliminary Remarks on the Subgenera of Cochlostyla.

I have followed Semper [2] in regarding *Axina* and *Corasia* as true *Cochlostylæ*, and von Möllendorff in adding [3] *Chloræa* and [4] *Ptychostyla* and excluding [5] *Phœnicobius*. Semper admits that the only distinction between *Cochlostyla* and *Chloræa* is that the latter exhibits some small anatomical difference in the genital apparatus, and this, as von Möllendorff justly remarks, is hardly sufficient reason for keeping it separate. The division of subgenera adopted by Semper

[1] About 240 are enumerated by Hidalgo, 'Journ. de Conch.' 3e sér. xxvii. 1887, pp.,111–192; but the list might be considerably narrowed by the reduction of many "species" to the rank of varieties, and the exclusion of several which are not true *Cochlostylæ*.

[2] 'Reisen,' II. iii. pp. 190, 166.

[3] Nachr. mal. Gesell. xx. 1888, p. 99.

[4] *Ibid.* p. 65.

[5] *Ibid.* xxiii. 1891, p. 200.

in the 'Reisen'[1] is admitted, even by its author, to be hardly satisfactory. But there is practically a general agreement between Semper and Pfeiffer[2], since both agree in the limitations represented by about 10 of the subgenera, the chief points of difference arising with regard to the respective limits of *Calocochlea* and *Helicostyla*, of *Helicobulimus* and *Orthostylus*, of *Orthostylus* and *Canistrum*, and the restriction of *Canistrum* proper. The distinction, if any, between some of these groups is, unless and until some definite anatomical difference is established, at best arbitrary. After careful consideration I have decided to abolish *Helicobulimus* altogether, merging it in *Orthostylus*. The species are in any case few (Pfeiffer enumerates only 5, and one of these, *grandis*, Pfr., is better classified as *Calocochlea*), and different authorities are much at issue with regard to referring specific forms to one group or the other. This seems sufficient reason for refusing to draw a line between them. With regard to *Orthostylus* and *Canistrum* (Pfr.), there is a very long series of forms ultimately connecting such typical *Orthostyli* as, e. g., *daphnis*, Brod., and *rufogaster*, Fér., with elongated shells like *camelopardalis*, Brod., and *nympha*, Pfr. But the extremes are so wide apart that it may be worth while to try to separate them, and I do so by regarding *pictor*, Brod., as a sort of border-line form, removing it from *Orthostylus*, and considering it and all the more elongated forms as belonging to a separate group (*Hypselostyla*, Mts.). This group is practically identical with Semper's '*Elongatæ*,' for there is strong ground for restricting, with Semper, the group *Canistrum* to a peculiar section of shells[3], the type of which is *ovoidea*, Lam. (=*luzonica*, Mörch, =*euryzona*, Pfr.).

The localities given in each case have been most carefully considered, and no species has been taken into account whose locality is not regarded as authoritative. Thus the locality 'Philippines,' so often given by the older writers, is useless for the present purpose, and species not further localized (a considerable number) have been neglected altogether. Recent investigation has been more exact in its record of localities, and in the present paper 180 species in all are brought to account. Further, it has been found necessary to neglect Cuming's authority as establishing any locality whatsoever. Those familiar with his method of preserving localities will understand this, and it need only be added that Semper and von Möllendorff are continually at issue with him. He may be taken as confirming, but

[1] (1) *Corasia*, (2) *Callicochlias*, (3) *Globosæ*, (4) *Hypomelanæ*, (5) *Cinereæ*, (6) *Axina*, (7) *Helicostyla*, (8) *Orustia*, (9) *Sphæricæ*, (10) *Cochlodryas*, (11) *Orthostylus*, (12) *Elongatæ*, (13) *Phengus*, (14) *Eudoxus*, (15) *Canistrum*, (16) *Prochilus*, (17) *Chrysallis*, (18) *Phœnicobius*.

[2] Nomencl. Hel. Viv. pp. 202–212. Von Möllendorff's paper on the subgeneric classification of *Cochlostylæ* (Jahrb. deutsch. mal. Gesell. xii. p. 72) places the divergence at its maximum.

[3] Semper, 'Reisen,' II. iii. p. 219, places in this section the following species:—*stabilis*, Sby., *euryzona*, Sby., *ovoidea*, Lam., *belcheri*, Pfr., *balanoides*, Jon., *breviculus*, Pfr., *cinerosa*, Pfr., *dilatata*, Pfr. I should agree with him with regard to the first five; *cinerosa* is probably a var. of *satyrus*, Brod., which is a *Hypselostyla*; the remaining two appear doubtful.

never as establishing, a locality. The main authorities are the two authors just mentioned, Hidalgo, von Martens, and Dohrn. Hidalgo's work requires special watchfulness, but on the whole his localities are trustworthy. No locality from Pfeiffer has been accepted unconfirmed.

No especial care has been taken to weed out synonymous species. This would involve another heavy piece of work, and would not materially affect the results arrived at.

Distribution of the Subgenera of Cochlostyla [1].

1. CHLORÆA.

Luzon, 6 : benguetensis, Semp., geotrochus, Möllf., hanleyi, Pfr., gmeliniana, Pfr., antonii, Semp., hügeli, Pfr. (all N. Luzon except hügeli, which occurs also in Central Luzon).
Marinduque, 2 : amœna, Pfr., [2] *fibula*, Brod.
Mindoro, 2 : thersites, Brod., constricta, Pfr.
Cebu, 2 : *fibula*, Brod., *sirena*, Brod.
Mindanao, 1 : *sirena*, Brod.
Tablas, 1 ; *dryope*, Brod.
Sibuyan, 1 : *dryope*, Brod.
Luban, 1 : *fibula*, Brod.

This subgenus is widely distributed without being specially characteristic of any island. It is not recorded from the large islands of Leyte and Samar, nor from S. Luzon, which is closely related to them. The true position of the so-called *Chloræa pelewana*, Mouss., from the Pelew Islands, cannot be said to be ascertained as yet.

2. AXINA.

Luzon, 3 : garibaldiana, D. & S., kobelti, Möllf., schadenbergi, Möllf.
Cebu, 6 : magistra, Pfr., zebuensis, Brod., cumingi, Pfr., moreleti, Pfr., carbonaria, Sby., phloiodes, Pfr.
Siquijor, 1 : siquijorensis, Brod.

The distribution of this subgenus is remarkably broken. It appears to replace *Calocochlea* in Cebu, and to be replaced by it in all the other islands except Luzon.

3. CORASIA.

[3] *Babuyanes*, 3 : [4] elisabethæ, O. Semp., [4] *albaiensis*, Sby., [4] halichlora, O. Semp.
Luzon, 8 : [4] *albaiensis*, Sby., psittacina, Desh., erubescens, Semp., pudibunda, Semp., livido-cincta, Semp., aurata, Sby., irosinensis, Hid., cærulea, Möllf.

[1] A very small island, lying quite close to a large one, with but little depth of water between, is regarded, for the present purpose, as forming part of the larger island.

[2] Species *italicized* are found on more than one island.

[3] *Elisabethæ* and *halichlora* from Calayan I., *albaiensis* from Camiguin de Luzon.

[4] These species may possibly be classified as *Calocochlea*.

Mindoro, 2 : *papyracea*, Brod., *ægrota*, Rve.
Catanduanes, 2 : reginæ, Brod., *papyracea*, Brod.
Marinduque, 1 : *filaris*, Val.
Tablas, 2 : *intorta*, Sby., *ægrota*, Rve.
Negros, 2 : *virgo*, Brod., *intorta*, Sby.
Cebu, 5 : *ægrota*, Rve., *virgo*, Brod., *papyracea*, Brod., *intorta*, Sby., magtanensis, Semp.
Limansana, 1 : limansanensis, Semp.
Bohol, 3 : valenciensii, Eyd., æruginosa, Pfr., *intorta*, Sby.
Panay, 1 : *intorta*, Sby.
Siquijor, 3 ; broderipii, Pfr., *papyracea*, Brod., *intorta*, Sby.
Mindanao, 8 : puella, Brod., cromyodes, Pfr., *filaris*, Val., *virgo*, Brod., *lais*, Pfr., *zamboangæ*, H. & J., *intorta*, Sby., saranganica, Möllf.
Basilan, 1 : *zamboangæ*, H. & J.
Soo-loo, 1 : *lais*, Pfr.

This appears to be the only subgenus of *Cochlostyla* not peculiar to the Philippines, if the species referred to it be correctly assigned. It occurs also in Tukan Bessi (off S.E. Celebes), perhaps in the Tular Islands (between Gilolo and the southern point of Mindanao), in Amboyna, in New Guinea, and in the Solomon Islands. It may be doubted whether any of these extra-Philippine species are really *Cochlostyla*[1].

4. Calocochlea.

Babuyanes, 3 : [2] *pulcherrima*, Sby., damahoyi, Pfr., chrysochila, Sby.
Luzon, 8 : festiva, Don., dataensis, O. Semp., *zonifera*, Sby., caillaudi, Desh., dubiosa, Pfr. (also in Alabat), *pulcherrima*, Sby., ponderosa, Pfr., erythrospira, Möllf.
Catanduanes, 2 : *coronadoi*, Hid., *norrisii*, Sby.
Mindoro, 4 : melanochila, Val., roissyana, Fér., dimera, Jon.
Tablas, 1 : *cocomelos*, Sby.
Sibuyan, 2 : *cocomelos*, Sby., *samarensis*, Semp.
Samar, 5 : *zonifera*, Sby., *norrisii*, Sby., speciosa, Jay, *samarensis*, Semp., *cryptica*, Brod.
Leyte, 6 : *zonifera*, Sby., *norrisii*, Sby., *coronadoi*, Hid., *sphærion*, Sby., cretata, Brod., fragilis, Sby.
Surigao, 1 : *latitans*, Brod.
Panaon, 1 : panaensis, Semp.
Bohol, 3 : *sphærion*, Sby., *latitans*, Brod., pan, Brod.
Mindanao, 11 : [3] chlorochroa, Sby., [3] mindanaensis, Sby., *zonifera*, Sby., *cryptica*, Brod., *sphærion*, Sby., circe, Pfr., depressa, Semp., cineracea, Semp., lignicolor, Möllf., retusa, Pfr.

[1] Fischer and Crosse (Miss. Scient. Mex. p. 296) actually describe as *Corasia* a shell from Mexico.
[2] All three species from Calayan I., *pulcherrima* also from Babuyan I.
[3] Camiguin only.

Evenly distributed over almost all the group, except where replaced by *Axina* (Cebu, Siquijor). One species (*sonifera*) is common to Luzon, Leyte, Samar, and Mindanao. A group within this group (Semper's *cinereæ*), consisting of *cryptica, latitans, cretata, panaensis,* and *cineracea*, occurs in the contiguous islands of Samar, Leyte, Surigao, Panaon, Bohol, and Mindanao, but not in Luzon.

5. Helicostyla.

Luzon, 14: curta, Sby., monticula, Sby., annulata, Sby., libata, Rve., *mirabilis*, Fér. (also in Alabat), montana, Semp., fenestrata, Sby., fumigata, Mts., balteata, Sby., sphærica, Sby., boettgeriana, Möllf., *metaformis*, Fér. (also in Alabat), [1] iloconensis, Sby., hindsi, Pfr.
Marinduque, 1: *mirabilis*, Fér.
Mindoro, 4: orbitula, Sby., tenera, Sby., fulgens, Sby., hydrophana, Sby.
Cuyos, 1: ignobilis, Sby.
Tablos, 3: crossei, Hid., bruguieriana, Pfr., turbo, Pfr.
Romblon, 2: *effusa*, Pfr., bembicodes, Pfr.
Sibuyan, 1: *effusa*, Pfr.
Cebu, 1: [2] *collodes*, Pfr.
[*Bohol*, 1: [3] *metaformis*, Fér.].

One of the few subgenera well represented in Mindoro in common with other islands. It occurs on the Tablas-Romblon-Sibuyan group, but is not recorded from any other of the central islands except Cebu (and *collodes* is a remarkably aberrant form), or from Leyte and Samar. The species are remarkably peculiar to the separate islands.

6. Cochlodryas.

Mindoro, 1: florida, Sby.
Burias, 1: polychroa, Sby.

A subgenus of very restricted and apparently broken distribution. Possibly 'Burias' may turn out to be incorrect.

7. Eudoxus.

Luzon, 1 ?: [4] *chloroleuca*, Mts.
Catanduanes, 3 ?: [1] *chloroleuca*, Mts., leopardus, Pfr., bustoi, Hid.
Mindanao, 6: smaragdina, Rve., straminea, Semp., ægle, Brod., cumingi, Pfr., paradoxa, Semp., oviformis, Semp.

[1] Given in error by Hidalgo from Mindanao: Semper especially records it as peculiar to Ylocos, a couple of provinces in N. Luzon.
[2] Wrongly given by Hidalgo from Zamboanga, S. Mindanao.
[3] The locality is due to Hidalgo, but he does not state his authority, and there can be little doubt that it is incorrect. Von Möllendorff, who collected in Bohol, does not mention it.
[4] The classification of this species, and its assignment to Luzon, are matters of doubt.

8. Orthostylus.

Luzon, 20: leucophæa, Sby., woodiana, Lea (also Alabat), porteri, Pfr. (also Polillo), lignaria, Pfr., rufogaster, Less., macrostoma, Pfr., vidali, Hid., *bicolorata*, Lea (also Alabat), polillensis, Pfr. (Polillo only), supra-badia, Semp., juglans, Pfr., nux, Semp., monozona, Pfr., concinna, Sby., flammula, Semp., turris, Semp., grandis, Pfr., *turbinoides*, Brod., amaliæ, Möllf., *pithogaster*, Fér. (also Alabat).

Catanduanes, 3: imperator, Pfr., codonensis, Hid., turbinoides, Brod.

Marinduque, 4: marinduquensis, Hid., *bicolorata*, Lea, *philippinensis*, Rve., villari, Hid.

Samar, 2: *philippinensis*, Rve., *pithogaster*, Fér.

Leyte, 1: *turbinoides*, Brod.

Panay, 3: turgens, Desh., *bicolorata*, Lea, *sarcinosa*, Fér.

Cebu, 4: *pithogaster*, Fér., *faunus*, Brod., *sarcinosa*, Fér., *daphnis*, Brod.

Bohol, 2: gilva, Sby., *daphnis*, Brod.

Masbate, 3: *pithogaster*, Fér., *faunus*, Brod., ticaonica, Brod.

Siquijor, 1: *daphnis*, Brod.

This subgenus is largely developed in Luzon and the central islands, but entirely absent from Mindoro and Mindanao. Several species are of wide distribution, e. g., *pithogaster* (Luzon, Samar, Cebu, Masbate), *daphnis* (Cebu, Bohol, Siquijor), *turbinoides* (Luzon, Catanduanes, Leyte). *Cochl. rustica*, Mouss., from Java, must be an *Amphidromus*: *C. viridis*, Desh., from Madagascar, is a *Helix*.

9. Phengus.

Luzon, 2: *romblonensis*, Pfr. (Calaguas only), opalina, Sby.

Marinduque, 7: *romblonensis*, Pfr., quadrasi, Hid., cossmanniana, Cr., *simplex*, Jon., eburnea, Rve., möllendorffi, Hid., subcarinata, Pfr.

Romblon, 1: *simplex*, Jon.

[1] *Burias*, 1: concinna, Sby.

This subgenus has its headquarters in Marinduque, and appears to have spread only to the islands in the immediate vicinity.

10. Canistrum.

Burias, 2: *ovoidea*, Lam., stabilis, Sby.

[2] *Masbate*, 1: *ovoidea*, Lam.

A small but well-marked subgenus of correspondingly well-marked distribution. Its true limitations have been indicated above.

[1] To these should perhaps be added *cincinniformis*, Sby., Luban, on the authority of a private collector, but I do not feel justified in placing it in the text. Pfeiffer strangely classifies the species in *Cochlodryas*.

[2] Ilocos Sur (N. Luzon) is given as a habitat for *balanoides*, Sby., by a private collector, but the authority is hardly sufficient.

11. Hypselostyla.

Luzon, 2: *dactylus*, Brod., *nympha*, Brod.
Catanduanes, 1: *dactylus*, Brod.
Marinduque, 1: *nympha*, Brod.
Leyte, 1: *camelopardalis*, Brod.
Panay, 3: [1] fulgetrum, Brod., nobilis, Rve., pictor, Brod.
Cebu, 1: *camelopardalis*, Brod.
Bohol, 2: boholensis, Brod., *camelopardalis*, Brod.
Busuanga, *Palawan*, and *Balabac*, 1: satyrus, Brod.

Characteristic of the central group, this subgenus just reaches Luzon and its southern attendant islands, but is entirely absent from Mindoro and Mindanao. Its appearance in Palawan and the Calamianes Islands is remarkable, no other subgenus being represented there.

12. Chrysalis.

Mindoro, 5: aspersa, Grat., mindoroensis, Brod., chrysalidiformis, Sby., electrica, Rve., antonii, Semp.

Entirely peculiar to Mindoro.

13. Prochilus.

Mindoro, 7: fictilis, Brod., virgata, Jay, porracea, Jay, calobapta, Jon., dryas, Brod., larvata, Brod., sylvanoides, Semp.
[2] *Cuyos*, 1: cuyoensis.

Not found out of Mindoro and (possibly) the Cuyos Is.

14. Ptychostyla.

Luban, 1: [3] cepoides, Lea.

Peculiar to Luban; one species only known.

15. Pfeifferia.

Luzon, 1: micans, Pfr.

Characteristics of the separate Islands.

Babuyanes.—This group, which may at a remote time have been connected with Luzon, but now is separated from it by a deep

[1] These three species from Panay, together with *satyrus*, form almost a group within a group, which is confined to Panay, the Calamianes, Palawan, and Balabac, in none of which islands do the more elongated *Hypselostylæ* occur.

[2] There is no authority but Cuming's for assigning this sp. to the Cuyos Is.; but as it does not appear to have been discovered anywhere else, there is considerable probability that the locality may be correct.

[3] Möllendorff, Nachr. mal. Gesell. xx. 1888, p. 65. A tablet in the Brit. Mus. has on the back, in Cuming's hand, "Island of Luban, leaves of trees." This locality had never been confirmed until one of von Möllendorff's collectors found the species living on Luban. Pfeiffer classified it as *Stylodonta*, Tryon as *Nanina*! Semper (Reisen, II. iii. p. 181) was the first to regard the species as *Cochlostyla*. He placed it in *Calocochlea*, suggesting, however, that a special group should be formed for so remarkable a shell.

channel, contains representatives of no subgenera which do not occur in Luzon. Only two subgenera (*Corasia* and *Calocochlea*) appear to be found there.

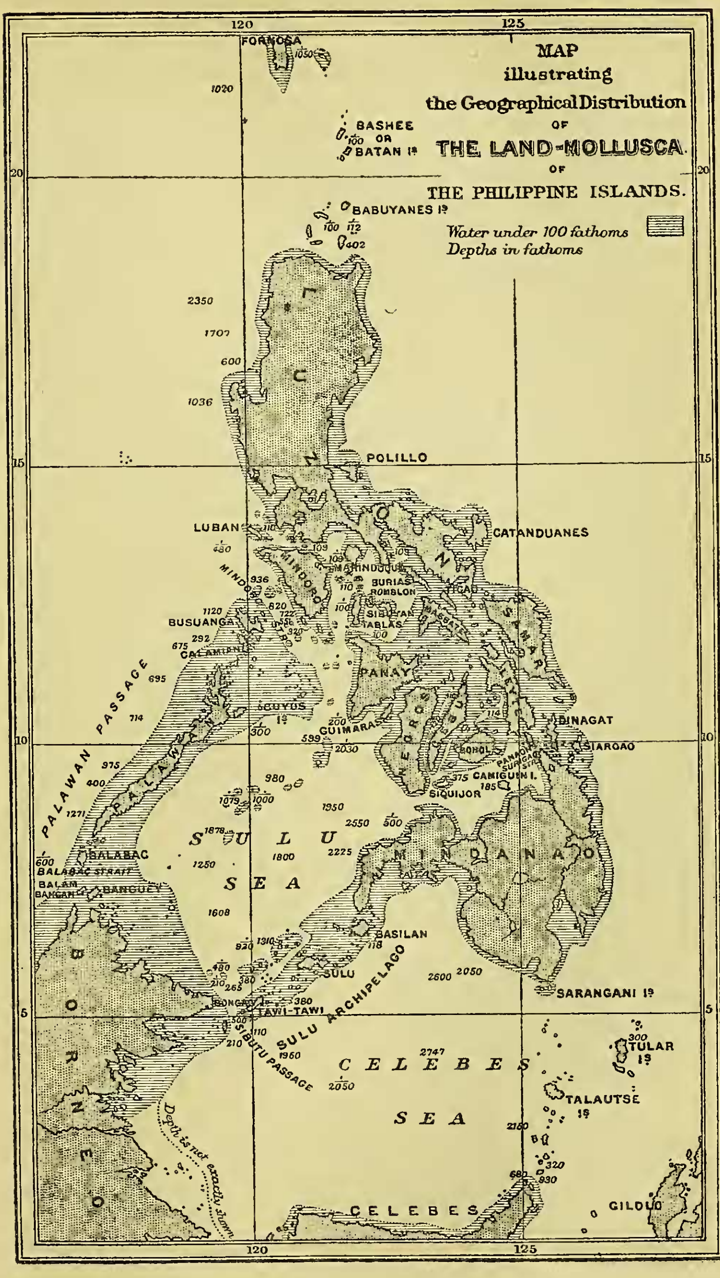
Luzon.—The great size of this island, exceeding as it does in area all the other islands, excepting Mindanao, taken together, and its wide extension to the S. and E., cause it, besides developing a rich fauna of its own, to receive immigrants from subgenera not indigenous to it. Thus there is no group which is not represented on Luzon, with the exception of those peculiar to Mindoro and Luban, but, on the other hand, there is no group (except *Pfeifferia*) peculiar to it. It is characterized by a rich development of the four subgenera *Corasia*, *Calocochlea*, *Helicostyla*, and *Orthostylus*; its neighbourhood to Marinduque gives it its 2 species of *Phengus*, to the central group its 2 species of *Hypselostyla*. Catanduanes, Polillo, and Alabat, the three islands on its eastern side, the fauna of which is well known, present no peculiar features; the channels separating them from Luzon are shallow, and they are practically a part of the main island.

Marinduque.—This island, although in other respects closely related to Luzon, stands out distinct from it in several respects, and is by no means so closely related to it as the islands just mentioned. The channel separating it from Luzon is deep, and apparently only just fails to exceed 100 fathoms in depth throughout its length. It is the metropolis of the subg. *Phengus*, 7 out of the 9 known species being found there. No species of *Calocochlea*, so abundant in Luzon, appears to occur. *Orthostylus* is abundant, and *Hypselostyla* is represented by one species.

Leyte and *Samar.*—These two islands, which are separated from one another by a very narrow and shallow channel, are closely related. The San Bernardino channel, which separates Samar from Luzon, is not of great depth, and accordingly no subgenus occurs on these two islands which does not also occur on Luzon. On the other hand, the Surigao passage, which separates Leyte from Mindanao, is, at least in part, of considerable depth, and we find accordingly that two out of the three subgenera hitherto recorded from Leyte do not occur in Mindanao. Neither of the islands can be said to be well explored. Only *Calocochlea* and *Orthostylus* are recorded from Samar, and the same two, together with *Hypselostyla*, from Leyte.

Burias and *Masbate.*—The subgenus *Canistrum*, so far as our information goes, appears to be peculiar to these two islands. This is the more strange, because the channel separating them from Luzon and from Samar is of no great depth, and the stretch of sea between Masbate and the N. coasts of Negros and Cebu is the largest piece of shallow water in the Philippines, scarcely exceeding 30 fathoms at any point. Eastward of Burias and Masbate the depths are considerable, and completely separate these islands from the Tablas-Romblon-Sibuyan group. Ticao does not appear to have been explored. *Orthostylus* is abundant on Masbate.

Tablas, *Romblon*, *Sibuyan.*—These three islands, which are separated by very deep water from all their neighbours, are closely


MAP
illustrating
the Geographical Distribution
OF
THE LAND-MOLLUSCA
OF
THE PHILIPPINE ISLANDS.
Water under 100 fathoms
Depths in fathoms
FORMOSA
BASHEE OR BATAN Is
BABUYANES Is
LUZON
POLILLO
CATANDUANES
LUBAN
MINDORO
MARINDUQUE
BURIAS
ROMBLON
SIBUYAN
TABLAS
MASBATE
SAMAR
LEYTE
BUSUANGA
CALAMIAN
PANAY
CUYOS Is
GUIMARAS
NEGROS
CEBU
BOHOL
BINAGAT
SIARGAO
SIQUIJOR
CAMIGUIN I.
PALAWAN
PALAWAN PASSAGE
SULU SEA
MINDANAO
BALABAC
BALABAC STRAIT
BANGUEY
BASILAN
SULU
SULU ARCHIPELAGO
TAWI-TAWI
SIBUTU PASSAGE
SARANGANI Is
TULAR Is
TALAUTSE Is
CELEBES SEA
CELEBES
GILOLO
BORNEO
Depths not exactly shown
120
125
20
15
10
5

related to one another. They have no subgenus peculiar, but their general relations are rather with Luzon than with the central islands. One species of *Phengus* indicates relations with Marinduque, while the complete absence of *Hypselostyla*, so common in Panay, separates them from the central group.

Cebu and *Bohol*.—These islands, with Panay, are the metropolis of *Hypselostyla*, which has spread northward to Luzon. Both are sharply separated from Mindanao, since neither *Orthostylus*, which is abundant in Cebu and Bohol, nor *Hypselostyla* is represented in that island, while on the other hand *Eudoxus*, which is abundant in Mindanao, is entirely absent from Cebu and Bohol. *Corasia* is abundant in both islands; *Axina* is not recorded from Bohol, while it is abundant in Cebu, which indeed contains 6 out of the 10 existing species. *Calocochlea*, on the contrary, which is entirely absent from Cebu, occurs freely in Bohol [1].

Panay.—This island appears, on a consideration of its fauna, to be rather isolated; but perhaps this may be accounted for by the fact that its nearest neighbour, Negros, has been scarcely explored. Its relations are with the central group, *Hypselostyla* being abundant and all its species peculiar to Panay. *Orthostylus* is the only other subgenus known to occur. Thus no connection is indicated with the Tablas-Romblon-Sibuyan group or with Mindoro.

Mindanao (including *Surigao* and *Camiguin*).—This great island presents some remarkable features. *Axina* is entirely absent, while *Calocochlea* is exceedingly abundant. *Corasia* appears to be confined to the extreme S., where it is abundant. *Phengus, Helicostyla*, and *Cochlodryas* are absent, and, what is more remarkable, *Orthostylus* and *Hypselostyla*, so abundant on Cebu and Bohol, do not occur, thus indicating a very considerable severance between Mindanao and the central islands. The channel immediately north of Mindanao is not well surveyed, but appears undoubtedly to be of very considerable depth, 185 fathoms having been recorded by the 'Challenger' close under the N. coast of Camiguin. The Surigao strait appears to be rather shallow on its eastern side, but as it opens out towards the west the depth appears rapidly to increase. A special feature of Mindanao is the development of *Eudoxus*, found elsewhere only in Luzon (?) and Catanduanes [2]. So far as we can at present make out the relations of Mindanao are rather with Luzon than with the islands immediately contiguous.

There seems every probability that the western part of Mindanao was once for a considerable time a separate island, completely disconnected from the central and eastern portions. The low and narrow neck of land, scarcely 20 miles across, lying between Iligan

[1] Hidalgo (Journ. de Conch. 3e sér. xxvii. p. 175) gives Cebu as a habitat for *calobapta*, Jon. This must be a mistake, as the species is a *Prochilus*, which is confined to Mindoro and, perhaps, the Cuyos.

[2] Hidalgo (Journ. de Conch. *ut sup*. p. 146) gives *C. roissyana* from "Surigao, dans l'île de Mindanao." I do not know any other authority for believing that *roissyana* is not peculiar to Mindoro. There is probably a misidentification of *C. sphærion*, Sowb.

Bay in the N. and Illana Bay in the S., appears to me to represent the original channel of separation [1]. *Corasia* occurs all over the island; its appearance and development must therefore have preceded the separating of the western portion. But *Calocochlea* and *Eudoxus*, the latter of which is almost peculiar to Mindanao, occur only in the N. and E. (e. g. *smaragdina* is found from Mainit in the extreme N. to Davao on the S.E. coast), and are not recorded from any point west of the narrow isthmus. Again, the section of *Chloritis* of which *H. spinosissima*, Semp., *quieta*, Reeve, and *sanziana*, H. & J., are well known examples, is almost peculiar to Mindanao, but is only found in the district to the W. of this peninsula, and does not appear to have penetrated the main portion of the island.

One species of *Corasia* (*zamboangæ*, H. & J.) is recorded from the island of Basilau (S. of Mindanao); the species is not peculiar, and occurs also on Mindanao.

Mindoro.—The general relations of this island are very remarkable, and cause it to stand out as by far the most isolated of the whole Philippine group. A glance at the map might incline us to regard it as a link between Luzon and Panay, with close relations to the former island, and with no cause for especial individuality. Mindoro, however, is incomparably the most isolated of all the Philippines. It contains one, possibly two, absolutely peculiar subgenera, which are very well marked, and of which the nearest relations appear to be with *Hypselostyla*. In other words, the relations of Mindoro, are, so far, but only very remotely, with Panay. At the same time, however, no existing subgenus appears to be common to the two islands. Probably further exploration may detect *Chloræa*, *Corasia*, and *Calocochlea* on Panay; but that would not bring its relationship to Mindoro at all closer, since these subgenera are known from almost every island. With Luzon Mindoro has, excluding the three subgenera universally prevalent, only one subgenus (*Helicostyla*) in common. All the species, however, are peculiar to Mindoro. Through this subgenus Mindoro appears also related to the Tablas-Romblon-Sibuyan group, and also to the Cuyos Is., but not to Panay. *Axina*, *Eudoxus*, *Orthostylus*, *Phengus*, *Canistrum*, and *Hypselostyla* are completely absent. *Cochlodryas*, however, is common to Mindoro and Burias only.

Cuyos Is.—These islands are very imperfectly known, but what little information we have tends to relate them with Mindoro, and not with Panay or Palawan. If Cuming's authority is to be trusted, the only two subgenera which occur in the Cuyos (*Helicostyla* and *Prochilus*) are common to Mindoro, but do not occur either on Panay or Palawan.

Luban.—This little island, lying almost between Luzon and Mindoro, must have been, in all probability, isolated for a long time. It contains one well-marked subgenus, *Ptychostyla*, which is quite peculiar. Deep water surrounds the island on every side.

[1] Most atlases, even the most recent, erroneously represent this isthmus as traversed by a lofty range of mountains.

Conclusions with regard to the Development of Cochlostyla.

It is probable that the distribution of *Cochlostyla*, above indicated, is due primarily to the union and separation of the various islands, perhaps more than once repeated. It can hardly be an accident which excludes *Orthostylus*, *Hypselostyla*, and *Helicostyla* from Mindanao, while *Corasia* and *Calocochlea* are not excluded, or which so sharply separates Mindoro from its near neighbour Luzon. The accompanying map (p. 455) shows that an elevation of the sea-bottom, of not more than 100 fathoms, would be sufficient to unite together all the great islands of Luzon, Leyte, Samar, Burias, Masbate, Bohol, Cebu, Negros, and Panay, not one of which is specially characterized by any one particular group, but all of which have a great many groups in common. The islands which would still remain isolated would be Luban, Mindoro, the Tablas-Romblon-Sibuyan group, Siquijor, and, possibly, Mindanao, all of which are characterized by the prominent absence or presence of marked subgenera [1]. When we know that the whole of the adjacent island of Borneo has been submerged for a depth of probably twice this amount, the probability that similar oscillations of level have occurred in the Philippines is largely increased, and, as a matter of fact, comparatively fresh coralline limestone occurs in many places in the islands at a height of at least 2000 feet above the sea [2]. There is no need to assume that the elevation and submergence affected all the islands simultaneously, or that it has not been several times repeated.

The conclusions that we arrive at by a study of the genus *Cochlostyla* are not illustrated, to any very considerable extent, by the distribution of other genera of Land-Mollusca occurring in the Philippines[3]. The natural inference is, that the genus *Cochlostyla*, as a whole, is of comparatively recent development, dating, in all probability, from a time much posterior to the introduction of the bulk of the Indo-Malay genera, and subsequent to the final separation of the group from Borneo and possibly from Celebes. The oldest of the subgenera appear to be *Chloræa*, *Corasia*, and *Calocochlea*, which are universally distributed, being common alike to Luzon, Mindoro, Mindanao, and the central group. *Orthostylus* and *Hypselostyla* were probably developed in the central group after the final separation of Mindanao. Mindoro and Luban (the only possessors of peculiar subgenera) must have been isolated very early, although perhaps the union of Mindoro with the Cuyos Is. continued after the separation of the former from Luzon and from Panay.

[1] The soundings in the Surigao Strait are, even in the most recent charts, very infrequent, and the extent of shallow water between Mindanao, Leyte, and Samar is probably exaggerated on the accompanying map.

[2] Mr. Everett writes to me as follows:—"Cebu, Siquijor, part of Bohol, almost all Leyte, N.E. Mindanao, Tablas, Romblon, and parts of Samar and Luzon are covered with thick caps of recent coral-limestone. There is a good deal of limestone in Palawan and the Calamianes. The island of Mindoro is . . . not overlaid (at least as seen from the sea) by recent coral-limestone, as so many of the Philippine group are."

[3] E. g. *Euplecta*, *Hemitrichia*, *Obbina*, which are almost peculiar to the group.

Relations of the Philippines to the neighbouring Islands.

The Philippines are connected with Borneo, and through Borneo with Java, Sumatra, and the mainland of S.E. Asia, by two distinct ridges or banks of elevation, which enclose between them the Soo-loo or Mindoro Sea. The first, or westernmost, of these, which stretches from a point S.W. of Mindoro to the northern Cape of Borneo, consists of the islands of Busuanga, Calamian, and Limicapan, of the great island Palawan or Paragua, and the smaller islands Balabac, Balambangan, and Banguey. The entire length of this ridge is somewhat over 400 miles, not including the channel (about 50 miles wide at its narrowest point) between Busuanga and Mindoro. Of this, about 350 miles is land, and about 50 miles water of less than 50 fathoms in depth. The easternmost bridge, which stretches from Zamboanga, the extreme western point of Mindanao, to the N.E. corner of Borneo, consists of a continuous chain of small islands, the Basilan group, and the Soo-loo Archipelago. This ridge is only about 225 miles in length, but the largest island of the chain is scarcely 40 miles long, as compared with Palawan, which is over 250.

On either side of both ridges the depth of the sea is profound. A deep submarine valley[1], with soundings of 670 fathoms to 1200 fathoms (the so-called 'Palawan passage'), runs in a N.E. and S.W. direction immediately west of and parallel to Palawan. The Soo-loo Sea is still deeper, soundings of 2225 fathoms and 2550 fathoms having been obtained off the S.W. coast of Mindanao, while profounder depths still have been fathomed in the Celebes Sea. A curious point about these ridges is, that a chasm occurs in each of them, and in each of them at one end, but not at the same end in both. The Palawan ridge is interrupted at its extreme northern end, between Busuanga and Mindoro, by a channel 50 miles broad and about 600 fathoms in depth (the Mindoro Strait). The Soo-loo ridge is interrupted at its extreme southern end by a channel only about 20 miles in width, but in parts over 500 fathoms in depth (the Sibutu passage). Were it not for these channels, a rise of 100 fathoms in elevation of the sea-bottom would make a double direct communication by land between the Philippines and Borneo.

There can be no doubt that Indo-Malay species of Mollusca have penetrated into the Philippines, in very early times, by both these ridges. Thus we find abundant in the Philippines the great *Naninæ* and *Cyclophori* so characteristic of the larger Sunda Islands. Four[2]

[1] It is important to notice this, since the 'Palawan passage' might be expected to mean the strait between Palawan and Borneo, whereas it means the fairway between Palawan and the dangerous ground to the west. Occasionally we find 'Palawan passage' given by inexact writers as a locality for Land-Mollusca, which is much as if 'Mozambique Channel' were given as a locality for a Madagascar *Cyclostoma*, or 'Bass' Strait' for a Tasmanian *Helix*. Pfeiffer (Mon. Hel. iv. 362) gives 'Palawan passage' for his *Bulimus trailli*, and Tenison-Woods (Proc. Linn. Soc. N. S. Wales, ser. 2, iii. p. 1003) gives the same locality for *Camæna trailli* and *palawanica*.

[2] *Amphidromus jayanus*, Lea, is probably not Philippine, and certainly not a *Cochlostyla*. Godwin-Austen records it (as a *Cochlostyla*) from Borneo (P. Z. S. 1891, p. 45).

species of *Amphidromus* are known from the Philippines (Sumatra 5, Java 15, Borneo 6); of these two get no farther north than Balabac, another occurs on Palawan, while two others are met with in Mindanao, and one of these has penetrated as far as Bohol and S. Leyte[1]. A detailed survey of some of the principal genera common to the Philippines and the neighbouring islands will be given below.

It would seem as if the connection which probably at one time existed between Palawan, Busuanga, and Mindoro was not directly across the present Mindoro Strait, where the depth is extreme. The Cuyos Is. appear to have shallow water to the W., and decidedly deeper water to the E.; thus their connection is with Palawan now. Again, the water shallows rapidly towards the S.E. end of Mindoro Strait, and is broken by islets and submarine banks, which extend from the S. point of Mindoro towards Panay and also towards Busuanga; the water, however, between these banks and islets is deep, being generally over 100 fathoms, and often more. The water off the N. and W. sides of Panay has not been very accurately surveyed, but is in all probability extremely deep. It would thus seem probable that any connection which may have existed between Mindoro and Busuanga (and a consideration of the very remarkable Helicidæ of both islands makes such a connection extremely probable) followed the line of shallower water at the E. end of the Mindoro Strait, and possibly extended some distance eastward towards Panay.

It will now be interesting to examine the Land-Mollusca of these two ridges, with a view of discovering whether or not they belong to the Philippine fauna.

Unfortunately, our knowledge of the Land-Mollusca of the Soo-loo ridge is meagre in the extreme. We know that Basilan, Lampinigan, and Malanipa are, by their *Cochlostylæ*, closely related to Mindanao. We know also that one species of *Cochlostyla* (*lais*, Pfr.) occurs on Soo-loo Is. Tawi-tawi[2] is quite unexplored. The Mollusca of Bongao, the last island at the Borneo end of the chain, are known. Eleven species in all are enumerated, five of which show distinct relations with Borneo.

The following species are known to occur on Basilan:—

Cochlostyla zamboangæ, H. & J.	Also occurs in	Mindanao.
Xesta mindanaensis, Semp.	,,	Mindanao.
Chloritis sanziana, H. & J.	,,	Mindanao.
Obbina rota, Brod.	,,	Bohol, Siquijor, &c.
Rhysota semiglobosa, Pfr.	,,	Philippines generally.
Macrochlamys crebristriata, Semp.	Also occurs in	Mindanao.
Microcystis myops, Semp. & Dhrn.	,,	Philippines generally.
Trochomorpha metcalfei, Pfr.	Also occurs in	Philippines generally.
Stenogyra panayensis, Pfr.	,,	Philippines generally.
Pupina ottonis, Dohrn.	,,	Mindanao.

[1] *Amph. maculiferus*, Sowb.; *see* Semper, Reisen, II. iii. p. 148.
[2] The 'Samarang' anchored off the island, but did not make a landing.

Thus Basilan is, as might be expected, thoroughly Philippine, not possessing even one peculiar species.

The Mollusca known from Malanipa are :—

Xesta mindanaensis, Semp.	Also occurs in	Mindanao.
Chloritis sanziana, H. & J.	„	Mindanao.
Obbina bigonia, Fér.	„	Mindanao, Leyte, Samar.
Leptopoma vitreum, Less.	„	Philippines generally.

The only Mollusca which appear to be known from Soo-loo are:—

Trochomorpha metcalfei, Pfr.
Cochlostyla lais, Pfr.
Melania soolooensis, Brot.
[1] *Cyclotus suluanus*, Möllf., MS.

According to Hidalgo[2], *Cochl. lais* occurs in N. Mindanao. The species is probably only a variety of *puella*, Brod. Pfeiffer originally described it from the Philippines generally; in the 'Novitates,' iv. tab. 126. ff. 6, 7, p. 114, he figures a var. said to be from Tukan Bessi, a locality which I greatly doubt.

In the absence of any information as to Tawi-tawi, it is impossible to say how far Philippine influence extends along this ridge.

The Mollusca known[3] from Bongao are :—

Plectotropis squamulifera, Möllf. Peculiar.
Macrochlamys angulata, Möllf. Peculiar.
Trochonanina conicoides, Metc. Peculiar.
Opeas, two species not identified.
Opisthoporus, sp. (possibly a *Cyclotus*).
Leptopoma, sp.
Lagochilus quinqueliratus, Möllf. Peculiar.
Alycæus excisus, Möllf. Peculiar.
Diplommatina roebelini, Möllf. Peculiar.
Pupina ottonis, Dohrn. Also occurs in Philippines.
Helicina martensi, Issel. „ Borneo.

Thus six out of the eight known species are peculiar, while of the remaining two, one occurs in the Philippines and one in Borneo. As to genera, no exclusively Philippine genus occurs, while *Plectotropis, Macrochlamys, Trochonanina, Opisthoporus, Lagochilus*, and *Alycæus* are Indo-Malay. In spite, then, of the deep intervening channel, Bongao is distinctly Bornean, and, in spite of the chain of islands with shallow water between them, distinctly non-Philippine.

Coming to the western ridge, the Mollusca known from Balabac[4] are as follows :—

Amphidromus[5] ? *entobaptus*, Dohrn. Also occurs in Palawan.

[1] In the Brit. Mus., from the Hungerford collection.
[2] Journ. de Conch. 3e sér. xxxv. p. 113.
[3] Von Möllendorff, Jahrb. deutsch. malak. Gesell. xiv. p. 286.
[4] From the island of Balambangan, on the Bornean side of Balabac Strait, are recorded *Ariophanta regalis*, Bens., and *Cyclophorus tenebricosus*, Ad. and Rve., and from an islet between Banguey and Balambangan, *Amphidromus adamsii*, Reeve.
[5] This is the species called by Hidalgo *contrarius*, Müll., which occurs in Timor.

Amphidromus quadrasi, Hid. Peculiar.
Lamprocystis goniogyra, Möllf. Also occurs in Philippines generally.
—— *myops*, Semp. & Dhrn. „ Philippines generally.
—— *succinea*, Pfr. „ Philippines generally.
Trochonanina labuanensis, Pfr. „ Borneo.
Hadra[1] *monochroa*, Sby. Also occurs in Palawan and Busuanga.
Cochlostyla[2] *satyrus*, Brod. „ Palawan and Busuanga.
Cyclophorus triliratus, Pfr. „ Borneo.
Opisthoporus quadrasi, Cr. Peculiar.
Leptopoma insigne, Sby. Also occurs in Mindoro.
—— *maculatum*, Lea. „ Luzon.
—— *vitreum*, Less. Also occurs in Java, Philippines, Moluccas.
Quadrasia hidalgoi, Cr. Peculiar.

Thus we find, even at the extreme Bornean end of this ridge, Philippine influence of considerable importance. The Bornean *Amphidromi* are counterbalanced by the *Hadra*, which belongs to the remarkable group of which the metropolis is Palawan, and by the single *Cochlostyla*. *Opisthoporus*, again, is Indo-Malay, while in the genus *Leptopoma* the preponderance, in species at any rate, is towards the Philippines. *Quadrasia* is a remarkable freshwater form, apparently allied to *Planaxis*, and quite peculiar to Balabac.

The Mollusca known from Palawan are as follows:—

Hemiplecta schumacheriana, Pfr. Also occurs in Borneo.
Hemitrichia (?) *plateni*, Dohrn. Peculiar.
Euplecta cebuensis, Möllf. Also occurs in Philippines.
Lamprocystis goniogyra, Möllf. „ Philippines.
—— *succinea*, Pfr. „ Philippines.
Trochonanina conicoides, Metc. „ Borneo, Bongao.
Trochomorpha loocensis, Hid. „ Philippines.
—— *metcalfei*, Pfr. „ Philippines, Borneo.
—— *splendens*, Semp. „ Philippines.
Amphidromus entobaptus, Dohrn. Peculiar, with Balabac.
*Hadra traill*i, Pfr. Peculiar.
——[3] *monochroa*, Sby. Peculiar to Palawan, Balabac, and Busuanga.
Eulotella (?) *inquieta*, Dohrn. Peculiar.
—— *fodiens*, Pfr. Also occurs in Philippines.
Cochlostyla[4] *satyrus*, Brod. Peculiar.
Cyclotus euzonus, Dohrn. Peculiar.
—— *sordidus*, Pfr. Said to occur in China and Cochin China.
Opisthoporus quadrasi, Hid. Peculiar.

[1] As *lagunæ*, Hid. This variable species appears to be confined to Balabac, Palawan, and Busuanga; Hidalgo (Journ. de Conch. sér. 3, xxvii. p. 109) cites it also from Luzon, but I think this must be a mistake.

[2] As the var. *graellsi*, Hid.

[3] Including the varieties *palawanica*, Pfr., *lagunæ*, Hid., *doriæ*, Dohrn, and *palumba*, Souv. Cuming gives *monochroa* from Tablas, which I think is a mistake. Dohrn considers the occurrence of *doriæ* in Borneo very doubtful.

[4] Including the varieties *graellsi*, Hid., *palavanensis*, Pfr., and *librosa*, Pfr.

Cyclophorus acutimarginatus, Sby. (?). Also occurs in Philippines.
—— *plateni*, Dohrn. Peculiar.
—— *quadrasi*, Hid. Peculiar.
—— *woodianus*, Lea. Also occurs in Philippines.
Leptopoma acuminatum, Sby. ,, Philippines.
—— *atricapillum*, Sby. ,, Philippines.
—— *distinguendum*, Dohrn. ,, Philippines.
—— *insigne*, Sby. ,, Philippines.
—— *luteostoma*, Sby. ,, Philippines.
—— *superbum*, Dohrn. Peculiar.
—— *vitreum*, Less. Also occurs in Java, Philippines, Moluccas.
Helicina martensi, Issel. ,, Borneo.

Of the 30 species above enumerated, 11 are peculiar to Palawan and the adjacent islands, while, of the remaining 19, 13 occur also in the Philippines only, 3 in Borneo, 2 are common to the Philippines and Sunda Islands, while one is assigned, perhaps wrongly, to China. If, however, we take the genera concerned, we find that 3 (*Cochlostyla, Hemitrichia, Euplecta*) are Philippine ; 6 (*Hemiplecta, Trochonanina, Amphidromus, Eulotella, Opisthoporus, Cyclophorus*) are Indo-Malay ; while the remainder are Moluccan and Polynesian genera which have spread into the Philippines and Sunda Islands. Palawan, therefore, affords a link between the Philippines and the Indo-Malay islands, without being very markedly allied with either group. Of Indo-Malay genera which do not appear to reach to the Philippines proper, it has *Opisthoporus*, while *Amphidromus* and *Eulotella* are but scantily represented there. Again, of genera peculiarly Philippine, it has the three above mentioned, so that the balance is fairly even. It is in its operculates, *Leptopoma* and *Cyclophorus*, that Palawan shows its closest relation to the Philippines.

The Mollusca known from Busuanga are as follows :—

Ennea (*Diaphora*) *möllendorffi*, Hid. Peculiar.
—— (——) *morleti*, Hid. Peculiar.
Kaliella doliolum, Pfr. Also occurs in Philippines.
Macrochlamys gemma, Pfr. ,, Philippines.
Lamprocystis glaberrima, Semp. ,, Philippines.
—— *globulus*, Möllf. ,, Philippines.
—— *goniogyra*, Möllf. ,, Philippines.
—— *myops*, Semp. & Dhrn. ,, Philippines.
Patula aperta (?). ,, Philippines.
Trochomorpha metcalfei, Pfr. ,, Philippines and Borneo.
—— *bintuanensis*, Hid. Peculiar.
—— *crossei*, Hid. Peculiar.
Trochomorphoides (?) *fernandezi*, Hid. Peculiar.
—— *planasi*, Hid. Peculiar.
Aulacospira azpeitiæ, Hid. Peculiar.
Trachia malbatensis, Hid. Peculiar.
Hadra [1] *polychroa*, Sby. Palawan and Balabac.

[1] As the var. *palumba*, Souv.

Phœnicobius bintuanensis, Hid. Peculiar.
—— *campanula*, Pfr. Peculiar.
Eulotella (?) *fodiens*, Pfr. Also occurs in Philippines.
Cochlostyla [1] *satyrus*, Brod. Palawan and Balabac.
Cyclophorus smithi, Hid. Peculiar.
Coptochilus quadrasi, Hid. Peculiar.

It is evident from this list that, as would be expected, Philippine influence is preponderant in Busuanga. Of the 23 species known, 12 are peculiar, and, of the remaining 11, 2 are also peculiar to Palawan and Balabac, 8 are common to the Philippines, and only 1 appears to occur in Borneo. *Amphidromus*, which occurred in Palawan, is not represented, but relationship with Palawan is sufficiently attested by the one *Cochlostyla* and by *Hadra polychroa*. The Indo-Malay *Opisthoporus* which reached Palawan appears to reach no farther. The occurrence of the *Diaphora* section of *Ennea*, which is only found elsewhere in Luzon, is a markedly Philippine element. *Kaliella* is a thoroughly Indo-Malay genus, which occurs sparingly in Java, Borneo, and the Philippines. The two species classified as *Trochomorphoides* are of doubtful generic position. Originally described as *Trochomorpha*, they were afterwards placed by their author in *Geotrochus*. In seems better to assign them to the genus in which Von Martens has placed several other Geotrochoid species (e. g. *bantamensis*, Smith, from Bantam I., off Java, and *niahensis*, Godw.-Aust., from N. Borneo), until their anatomy has become definitely known.

By far the most interesting part of the molluscan fauna of Busuanga are its Helices. Only three are known, viz. *campanula*, Pfr., *bintuanensis*, Hid., *polychroa*, Sby. These three species belong to two groups closely related to one another. One of these groups is represented in Palawan, the other in Mindoro, Busuanga uniting the two by possessing both. There can be little doubt of the very close relationship of *campanula* and *bintuanensis* (together with *ceres*, Pfr., probably from this same locality) with the species so long regarded as a group of *Cochlostyla* (*Phœnicobius*), but now separated off by von Möllendorff as a group of Helices of the Camœna family. The curiously stumpy form, thick and roughly toothed lip, and often wrinkled sculpture are marked points of similarity throughout. The other group, that of *polychroa*, is more of the normal helicoid type, but is linked with *Phœnicobius* by the form *trailli*, Pfr., which presents points of analogy with both groups.

This occurrence of a number of large Helices of very restricted distribution (*Phœnicobius* being peculiar to Busuanga and Mindoro, and the *polychroa* group to Busuanga, Palawan, Balabac, and perhaps N.E. Borneo) is exceedingly remarkable. The evidence that the *polychroa* group extends to Borneo is not strong. *H. trailli* and *H. palawanica* are given from Borneo in the Brit. Mus. on the authority of Mr. Ussher, Consul at Labuan about 15 years ago. Issel, however, in his monograph of Bornean Mollusca, gives these same species, not from Borneo, but from 'Stretto di Palawan,' which probably means

[1] As the var. *fischeri*, Hid.

Balabac. The mistake about "Palawan passage," alluded to above, has perhaps induced collectors to assign to both sides of the supposed "passage" species that really came from one side only. The only form that appears to have any real authority as coming from Borneo is *H. doriæ*, Dohrn, and I do not feel absolutely certain even about it, while Dohrn himself is very doubtful. But, whether the group be represented in Borneo or not, it is interesting to consider the relationship of these two very isolated groups of Helices, which, it may be remarked, afford very strong evidence for a land connection at some point between Mindoro and the Calamianes. It appears to me that both of these groups find their nearest relations in an easterly and not in a westerly direction—the *Phœnicobius* group being nearly akin to the well-known forms *mamilla* and *papilla*, from N. Celebes, and these to *concisa*, Fér., from Waigiou, and *quoyi*, Desh., from Celebes; the *polychroa* group to shells of the type of *rehsei*, Mart., from N. Guinea, and *dupuyana*, Cpr., from N.E. Australia. It is certain that, as far as these regions are concerned, it is only in N. Guinea and N. Australia that Helices are found of the size and general texture of those under consideration. And it is perhaps worth while pointing out other affinities of the same kind. The remarkable *H. antiqua*, Ad. & Rve., from N. Borneo, appears closely allied to no other shell but *leonardi*, Tapp.-Can., from N. Guinea. The unique *H. plurizonata*, Ad. & Rve., found during the 'Samarang' voyage in Mindanao, is very nearly related to *lacteolota*, Sm., and *agnocheilus*, Sm., both from N. Guinea [1]. The *Corasiæ* of the Philippines are closely related to a group of shells which attain their maximum development in the Solomon Islands. The section of *Chloritis* which includes such Helices as *quieta*, Rve., *brevidens*, Sby., *spinosissima*, Semp., *sauliæ*, Pfr., *sanziana*, H. & J., *caliginosa*, Ad. & Rve., and *philippinensis*, Semp., has its nearest relations in N. Guinea, Torres Str., and N. Australia. And it is perhaps worth noticing that the Philippine *Chlorites* just mentioned appear to be restricted to the two islands of Mindanao and Mindoro, *i. e.* just where the two ridges of connection impinge upon the Philippine group.

These facts seem to point to a land connection, no doubt of extreme antiquity, which admitted of Land-Shells of a Papuan and N. Australian type finding their way in a westerly direction. I am therefore inclined to regard *Phœnicobius* and the *polychroa* group, as now occurring in Palawan, Mindoro, and the adjacent islands, as a sort of survival of a fauna which perhaps had once a much more extended range. It is a significant fact that almost the only other *Helix* from the E. Indies generally which in shape at all approaches the smaller forms of the *Phœnicobius* group is *H. codonodes*, Pfr., from the Nicobars. It is possible that eventually fossil or subfossil forms may be discovered in Sumatra and Java which will place this at present isolated form in continuous geographical connection with the apparently related fauna of Busuanga and Mindoro.

[1] Had the 'Samarang' been anywhere near N. Guinea, one might have been disposed to believe that the locality for *plurizonata* was erroneous; its facies is so strongly Papuan.

A word may be added with regard to three groups of islands which link the Philippines with other points of geographical interest. These are the Tular Islands, the Talautse Islands, and the Bashee or Batan Islands.

The Tular Islands are situated between Mindanao and Gilolo, in Lat. 4° N., Long. 127° E. The only Mollusca which appear to be known from them are [1] *Helix physalis*, Pfr., and *Partula newcombiana*, Hartm. Ancey [2] doubts the correctness of the locality for the latter (Salisbaboe Island, one of the group). It is certainly, if correct, the most westerly *Partula* known, the few species from the Pelew Islands coming next. The Tular Islands are known to be volcanic, and a more thorough knowledge of their fauna, as illustrating the relations between Mindanao and Gilolo, would be most interesting. The depth of water, both to the north and south of the group, is extreme.

From Sanghir, the largest of the Talautse Islands (situated in Lat. 3° N., Long. 125° E.), the only Mollusca known are *Cyclophorus sericatus*, Anc., and *Obba linnæana*, Pfr. The latter is a very interesting shell, and approximates closely to the Celebesian forms *mamilla*, Fér., and *quoyi*, Desh. In the Brit. Mus. there is a tablet of *Corasia leucophthalma*, Pfr., from Sanghir Island, but I do not feel confident of the authority.

The Bashee or Batan Islands, lying midway between Luzon and Formosa in Lat. 21° N., Long. 122° E., appear not to have been visited by a naturalist since the voyage of the ‘Samarang.’ They are a continuation of the volcanic chain which runs through the Philippines, Formosa, and the Loo-Choo Islands to Japan and Kamtschatka. The depth of water all round them is profound, 1000 fathoms being recorded immediately off the S. point of Formosa, while the Ballintang Channel, which separates the Bashee Islands from the Babuyanes, is certainly of great depth. The only Mollusca known from these islands are *Helix batanica*, Ad. & Rve., *Cochlostyla ? speciosa*, Jay, and *Bulimus kochii*, all from the island of Ibugos (‘Samarang,’ Zoology *Preface*, Narrative, vol. i. p. 72). *Helix batanica*, a sinistral species, appears to be of a thoroughly Chinese or Formosan type, belonging to the same section as *peliomphala*, Pfr., *formosensis*, Pfr., and *bacca*, Pfr. The *Cochlostyla*, on the other hand, is of course Philippine, and it is very remarkable that the species should occur on an island separated by such great depths from the Philippines proper. What the exact species may be is uncertain. Adams originally considered it to be *C. speciosa*. Reeve afterwards described it (Conch. Ic., Helix, pl. ix. f. 2) as *batanica*, afterwards altered to *volubilis*. Pfeiffer regarded it as either his *dubiosa* or as *decipiens*, Sowb. Hidalgo thinks it a variety of *damahoyi*, Pfr. (Journ. de Conch. 1887, p. 129). What ‘*Bulimus kochii*’ may be (Adams says it occurred in three varieties,

[1] Described in Mal. Blätt. xviii. 1871, p. 123, from Mr. J. H. Thomson's collection. In the Nomenclator Hel. Viv. it is classified as a *Cochlostyla*. An examination of specimens in Mr. J. H. Ponsonby's collection, received from Mr. Thomson, makes me very doubtful on this point.

[2] Le Nat. 1889, p. 266.

but he does not figure any) I am quite unable to suggest. If an *Amphidromus*, the balance of connection would be, on the whole, with Formosa. The further investigation of the Mollusca of this interesting group is very desirable.

In the following table (pp. 468, 469) are examples of Indo-Malayan genera which reach the Philippines.

The following Indo-Malayan genera occur in the Philippines, but have not yet been detected in Sumatra, Java, or Borneo, viz.:—*Hypselostoma* (*philippinicum*), *Plectopylis* (*polyptychia*, *trochospira*), *Ditropis* (*mira*, *cebuana*, *quadrasi*), *Cyathopoma* (*cornu*, *meridionale*, *aries*).

Of Moluccan and Polynesian genera occurring in the Philippines, and gradually diminishing through the Sunda Islands westward, the following may be mentioned:—*Trochomorpha*: Philippines 9, Borneo 8, Java 8, Sumatra 4; *Helicina*: Philippines 16, Borneo[1] 3, Java 1, Sumatra 0; *Leptopoma*: Philippines 31, Borneo 11, Java 2, Sumatra 1; *Cyclotus*: Philippines 18, Borneo 6, Java 2, Sumatra 1; *Pupina*: Philippines 5, Borneo 3, Java 5, Sumatra 3. Two species of *Tornatellina* (*manillensis*, *ringens*) occur in the Philippines, but not farther westward, one of *Endodonta* (*philippinensis*), and one of the *Leucochilus* section of *Pupa* (the pan-Polynesian *pediculus*).

There seems to be a good deal of misunderstanding with regard to the island Tukan Bessi (variously spelled Toekang Besi, Toukang basi, Tukang Bessie, Toekun Bessi). It originally came into notice as the habitat of three supposed *Cochlostylæ* (*thomsoni*, Pfr., *indusiata*, Pfr., *tukanensis*, Pfr.), described (as *Helices*) by Pfeiffer in Malak. Blätt. xviii. 1871, p. 120, f., from the collection of Mr. J. H. Thomson; the same locality is repeated in each case in the 'Novitates,' vol. iv. pp. 71–73. Kobelt, in his papers on geographical distribution, quotes Issel (Monogr. Bornean Mollusca) as referring one of these species to "the small islands north of Borneo," and in his list gives *Cochlostyla lais*, *tukanensis*, and *physalis* all from "Toekun Bessi." Von Möllendorff (Jahrb. deutsch. malak. Gesell. xiv. p. 285) remarks that this island, as well as Tular and New Beland, lies between the S. point of Mindanao and the Moluccas. The only Tukan Bessi with which I am acquainted is off the S.E. point of Celebes, in Lat. 4° S., Long. 124° E., and therefore well away from the Sulu Sea or the Celebes Sea proper. No island of such a name, or of a name anything approaching it, appears on the chart of the seas north of Borneo. Either, therefore, the original locality of Mr. Thomson's shells was incorrect, which there seems no reason to believe, or the island has been wrongly located by succeeding writers. What the island of "New Beland" is, to which Möllendorff refers, and from which Von Martens describes[2] his *Cyclotus angulatus*, I am quite unable to conjecture.

[1] Lieut.-Col. Godwin-Austen (P. Z. S. 1889, p. 352) adds *crossei*, Semp., to the Bornean fauna, on the authority of the Brit. Mus., which has specimens from "Palawan." I suspect this is an error. Semper's original locality was Palauan in Luzon.

[2] Jahrb. deutsch. malak. Gesell. i. 1874, p. 56.

EXAMPLES OF INDO-MALAYAN GENERA OF LAND-MOLLUSCA WHICH REACH THE PHILIPPINES.

	SUMATRA.	JAVA.	BORNEO.	CELEBES.	PHILIPPINES.
Sitala	....	bandongensis.	angulata. everetti. singularis. kusana. orchis.	....	philippinarum. lineolata.
Amphidromus	inversus. sumatranus. jayanus. adamsi. porcellanus.	appressus. purus. galericulum. bataviæ. loricatus. sultanus. interruptus. emaciatus. porcellanus. leucoxanthus. perversus. palaceus. winteri. furcillatus. filozonatus.	melanomma. interruptus. perversus (?). chloris. maculiferus. adamsi.	sinistralis. perversus. interruptus. sultanus. beccarii. annæ.	chloris. maculiferus. entobaptus (Palawan). quadrasi (Balabac).
Clausilia	sumatrana. excurrens. obesa. alticola.	javana. heldii. corticina. cornea. junghuhni. moritzii. orientalis. salacana.	bornensis. schwaneri. dohertyi.	moluccensis.	cumingiana.
Kaliella	....	javana.	pulvisculum.	....	pseudositala. pusilla. stenopleuris. luzonica. doliolum.

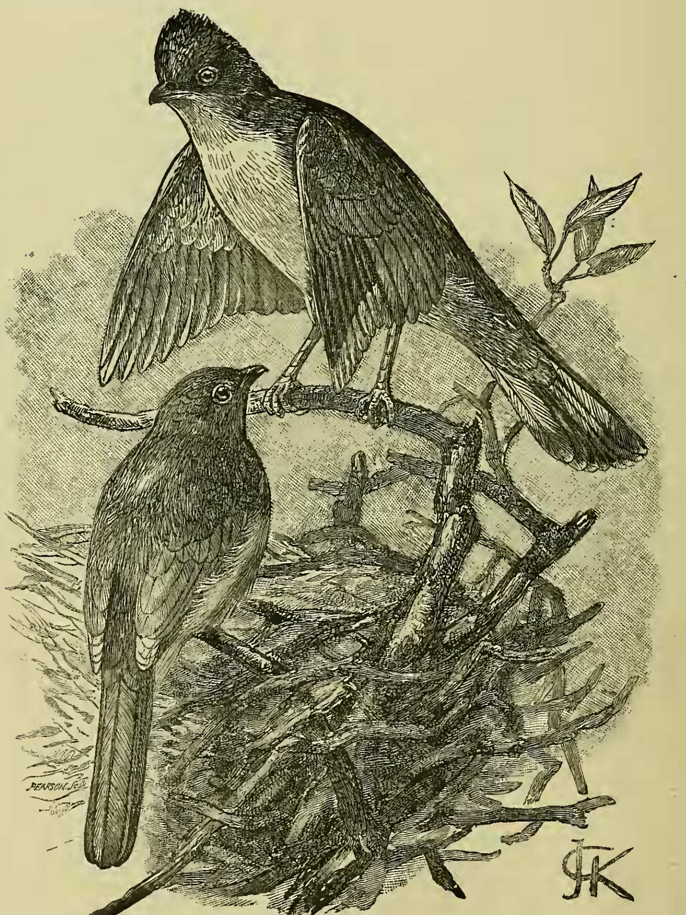
Glessula	sumatrana.	cornea. javanica.	wallacei.	....	philippinensis.
Plectotropis	sumatrana.	winteriana. sumatrana. squamulosa.	....	....	visayana.
Lagochilus	garreli.	grandipilum. ciliferum. trochulus. ciliocinctum.	dido. keppeli. mundyanum. triliratum.	ciliocinctum. bellum.	boettgeri. subcarinatum. tigrinulum. mucronatum. grande. parvum. omphalotropis. quadrasi. stenomphalus.
Opisthoporus	sumatranus. rostellatus. javanus.	corniculum. biciliatus. javanus.	biciliatus. euryomphalus. latistrigus. rostellatus. birostris. pterocycloides. pertusus.	....	quadrasi (not farther than Palawan).
Alycæus	longituba.	hochstetteri. jagori.	hochstetteri. globosus. spiracellum. broti. galbanus. hosei. everetti. specus.	jagori. celebensis.	caroli. tomotrema.
Coptochilus	sectilabrum. sumatranum.	....	anostoma. doriæ.	....	altum.

June 14, 1892.

Prof. Flower, C.B., LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of May 1892:—

The total number of registered additions to the Society's Menagerie during the month of May was 136, of which 80 were by presentation, 20 by birth, 22 by purchase, and 14 on deposit. The total number of departures during the same period, by death and removals, was 75.



Hypocolius ampelinus, ♂ et ♀.

Amongst the additions I may invite special attention to a pair of the rare and beautiful Passerine bird the Grey Coly-Shrike (*Hypocolius* *ampelinus*) from Fao, Persian Gulf, presented by W. D. Cumming, Esq., and received May 6th. We had previously received from the same donor a male of this bird, which is still alive and in splendid condition. The drawing by Mr. Keulemans which I exhibit (see p. 470) shows the attitude taken by the male of this species when courting.

Mr. Sclater made some remarks on the Zoological Gardens at Rotterdam, the Hague, Amsterdam, and Antwerp, which he had visited since the last meeting, and on the principal animals he had noticed in each of them.

At Rotterdam was an example of an Antelope lately received from the Congo, a male of *Cephalolophus sylvicultor* or of a nearly allied species, believed to be the first example of this fine animal brought to Europe. Besides this, the specimens of *Tragelaphus gratus* and *Cephalolophus badius* (*cf.* P. Z. S. 1891, p. 327) were still living. In the Monkey-house were examples of *Macacus ocreatus*, *M. speciosus* of Japan, and *Semnopithecus pruinosus* of Java. The Zebras were represented by a pair of *Equus burchelli chapmanni*. Amongst the birds, Mr. Sclater had noticed examples of *Gyps rueppelli*, *Ketupa javanensis*, a fine series of six Snowy Owls (*Nyctea nivea*), *Squatarola helvetica* in full summer plumage, *Trichoglossus forsteni* of Sumbawa, *Ardetta sinensis* from Java, *Plotus anhinga* (a fine adult bird), and *Gallinula orientalis* from Java.

The Heronry in the Rotterdam Gardens (of wild herons, see P. Z. S. 1891, p. 327) was in full vigour, there being 28 nests this year, and a pair of Black Storks (*Ciconia nigra*) were nesting inside the adjacent Night-Herons' Aviary.

At the Hague Zoological Gardens the greatest attraction was the large series of caged European Passeres, many Sylviidæ (e. g. *Ruticilla phœnicurus*, *R. titys*, *Sylvia cinerea* and *S. curruca*) being amongst the number.

At Amsterdam the principal Antelopes noted were a pair of *Hippotragus equinus* and a female of *H. niger*; a pair of *Cobus ellipsiprymnus* and 3 males and a female of *C. defassa* [1]; also examples of *Gazella dama*, of both species of Gnu, and of *Bubalis albifrons*. The herd of *Tragelaphus gratus* was still flourishing, and consisted of two males, two females, and a young male lately born. A *Cephalophus* lately received from Western Africa appeared to be *C. nigrifrons*. The Giraffes had become reduced in number to a single female, but there were a fine pair of Mountain Zebras (*Equus zebra*) and a young one.

From the Zoological Gardens at Antwerp a number of desirable acquisitions had been obtained for the Society's Collection, amongst which were examples of *Casuarius uniappendiculatus*, a male Ostrich, and a pair of Victoria Crown-Pigeons (*Goura victoriæ*). A young male Hippopotamus, born on the 6th September, 1891, the fourth of the offspring of the adult pair now for several years in these Gardens, seemed to be in splendid health and condition. It was hoped that this animal might be acquired later on for the Society's Collection.

[1] *Cobus sing-sing* (Bennett), Cat. Vert. 1883, p. 144.

Mr. Sclater had also visited the private Menagerie of the Society's Corresponding Member, Mr. F. E. Blaauw, of Westerveld, s'Graveland, Hilversum, and admired the beautiful herd of White-tailed Gnus, and the flocks of Rheas of both species (*Rhea americana* and *R. darwini*) and the fine series of Water-fowl to be seen there. A pair of Mantchurian Cranes (*Grus viridirostris*) were found engaged on the duties of incubation, and both *Bernicla poliocephala* and *B. rubidiceps* with young birds lately hatched [1].

A communication was read from Mr. T. D. A. Cockerell, F.Z.S., of the Institute of Jamaica, containing an account of the occurrence of a specimen of the Jacana (*Jacana spinosa* [2], Cory, B. W. I. p. 252) in Jamaica.

On April 20, 1892, Dr. Alex. G. McCatty, of Montego Bay, Jamaica, had sent a specimen of this bird to Mr. F. Cundall, Secretary of the Jamaica Institute, stating that it was quite new to him and had been shot by his friend Mr. Dillon at Savanna-la-Mar, where it is known to the people as the "Banana or Plantain Coot." This was, so far as Mr. Cockerell knew, the first certain record of the Jacana in Jamaica. There was, however, in the Museum of the Institute of Jamaica, a skin of a Jacana presented by Mr. H. O. Vickers in 1886, which was said to have been shot by that gentleman in Westmoreland Parish, Jamaica.

In a subsequent letter (dated May 14th) Mr. Cockerell had written as follows:—

"Since writing on this subject I have learned, from Mr. R. A. Walcott, Resident Magistrate for Westmoreland, that the Jacana is certainly resident in Jamaica. It was first observed by a party of gentlemen, of whom Mr. Walcott was one, in 1874, on the Cabaritta River. Since then it has occurred regularly, being observed in the Meylersfield Morasses, between Savanna-la-Mar and Little London, along the banks of the Cabaritta, and at the ponds at Hodges, near Black River, in St. Elizabeth. Although there is no history of its importation, it seems probable that it must have been brought to Jamaica from the mainland about 1873, as the rather numerous sportsmen of Westmoreland and St. Elizabeth would surely have observed it, had it existed there earlier. Its arrival by natural means seems out of the question, as Mr. Walcott informs me that it cannot fly long distances."

Dr. J. Anderson, F.R.S., F.Z.S., read the following notes on the occurrence of *Spalax typhlus* in Africa:—

"Towards the end of last April, while in Lower Egypt, I found in the district of Mariut, to the west of the great lake of the same name, and about eight miles from Alexandria, the rodent exhibited to-night.

"I may mention, in order to convey to you some idea of the character of the Egyptian habitat of this animal, that unlike the delta

[1] For a report on Heer Blaauw's collection, see "Educations d'Animaux faites à s'Graveland (Hollande) en 1891," Rev. Sc. Nat. Appl. 1892, p. 449.

[2] Melius *Parra gymnostoma*, Wagl.

proper the Mariut district consists of low rounded hills, that form a barrier between the lake and the sea. They are, however, of no great height, as the highest eminence does not rise probably more than 80 feet above the sea-level. On the gentle slopes rising from the lake, on the small plains, and in the hollows in the undulations, the Bedouins who form the greater part of the sparse population sow their crops, chiefly barley, trusting to the very meagre and uncertain rainfall of winter and spring for the irrigation of the land. If there is a moderate rainfall, the entire area, I am informed, presents in spring a beautifully green and comparatively luxuriant appearance, being covered with various flowering plants, among which Asphodels and Hyacinths abound, and by the crops of the Bedouins, which afford these people a fair return under such conditions. However, I was not favoured with such a pleasing scene during my visits, as everything was dried up, the rainfall of the past winter and of this spring being remarkedly deficient.

"On my excursion we met an Arab working in his stunted barley-field, and on questioning him about the different kinds of animals found in the district, he mentioned one which he said was completely blind and that burrowed on the higher ground and threw up mounds of earth, the character of which he illustrated by taking a handful of soil and dropping it into little heaps resembling mole-hills. I was at first incredulous and told him that in order to convince me of its presence it would be necessary for him to show me one, and I promised him 10 francs for the first he should bring alive to Alexandria. Two days afterwards he appeared at Abbatts Hotel with one in a strong canvas bag, which when opened was found to contain an animal certainly blind, as no external trace of eyes could be detected, the area which the eye should have occupied being entirely covered with skin and fur.

"I appointed a day on which to return to Mariut, and arranged with him that he should meet me near his village, and that we should dig out the animal together, he having previously sought out a place in which he had satisfied himself the animal was to be found.

"On meeting him on the day appointed, he led me to a little level flat, on the upper margin of a barley-field, and approaching it carefully he stopped short and pointed out a small hole he had dug and in which fresh earth had recently been thrown up, as if by a mole. In making the hole he had cut through two of the passages of the burrower, and he knew that in leaving them exposed the animal, if it were in either of them, would close the one in which it happened to be by throwing out earth, that would be more moist than the surrounding soil and thus indicate its presence. Having thus satisfied me that an animal was in this spot, he led me higher up to another and still larger level expanse covered with little mounds and with the dried stalks of Asphodels. Here, again, he had taken the same precaution to find out the whereabouts of the burrower. Selecting one passage we commenced to dig, but we had not proceeded far when we found that it gave off secondary tunnels, which had to be dug up to their blind extremities. As some of these passages were nearly 30 to 40 yards long, the work of opening them up occupied some time; but as the soil was not hard and the tunnels not more than 18 inches, as a rule, below the surface, the work was accomplished more quickly than it would have been had the conditions been less favourable to digging. When a secondary tunnel was encountered its opening was closed while the main run was traced to its end, and then the secondary one was taken up, and so on until at last all the runs were searched from the points at which they had been cut across, and then the other sections in the opposite directions were taken in hand. We followed some of these to a depth of four feet, and there the passages were numerous and some of them very short and running above others below them. In one place, three runs were observed side by side, but all ultimately diverged from each other. In following one of these to the depth just mentioned we came upon a domical chamber packed full of bulbs, some of which are exhibited. My wife counted them as they were handed out and they reached the number of 68. Adjoining this chamber was another, quite empty, and which the Arabs said was the sleeping apartment. A passage leading off from these chambers was followed up for a short distance, when we came upon the animal moving backwards in it, retreating as we gradually shortened its burrow, which proving to be a *cul-de-sac* rendered the capture of the rodent an easy matter. All the passages dug up seemed to radiate outwards from these chambers; but we did not see any other store chambers, as the two other animals we captured were found in runs near the surface. However, in following up one animal we came upon a chamber the floor of which was covered with a nest of leaves. The digging out of these three animals occupied us four hours.

"The tunnels are perfectly smooth and cylindrical, and in digging through the soil above them numerous bulbs of the same kind as those found in the store-house were observed. The runs are therefore tunnels made by the animal in search of its food.

"I kept the three animals beside me for some time before sending them off by steamer for London, placing each in a large tin box half filled with earth and sand. I observed that when a number of bulbs were given to them they manifested their hoarding instinct by carrying them between their powerful teeth to one spot, where they deposited them—a very striking performance in an animal devoid of sight. The probability is that, in actions of this kind, it is guided by the sense of smell, the other sense which is most developed being that of hearing, even although there is no external ear, this part of the acoustic organ being reduced to a tube beginning on a level with the external skin, but of considerable capacity. The animal is endowed with wonderful activity and is very restless at night, thus still retaining a habit of life which, although probably of no use to it now, is generally characteristic of its close allies. It would be very interesting to know whether it ever comes above ground, as the Arabs assert that males and females are never found in the same burrows. The area, however, which I examined was so cut up by runs from various centres that it is easy to conceive that the burrows of different sexes occasionally intersect and communicate with one another.

As an illustration of the energy of this animal and of the strength resident in its neck-muscles and head, I may mention that one of them forced open, during the night, one end of the overlapping lid of the tin box in which it was confined, and escaped, even although the lid was firmly tied down in the middle and was weighted above. It achieved this feat by standing on its hind legs and by inserting its broad spatulate head between the lid and the box. In the morning it was found concealed between the folds of the cover of a dressing-bag.

"The chief object of this note, however, is not to record the habits of this remarkable animal, but to place on record its occurrence in Egypt. It was known to Aristotle, and during the last two centuries it has been described and figured by many naturalists. It is the only representative of the genus *Spalax*, if these Egyptian individuals prove to be the same as the European animal, which is found in Poland, Southern Hungary, and Eastern Russia, indeed over nearly the whole of South-eastern Europe, extending, as pointed out by Olivier in the beginning of the present century, to Syria, Mesopotamia, and Persia, and of late years found by Canon Tristram in Palestine as far south as the neighbourhood of Jerusalem, and by Mr. H. C. Hart at Gaza. If I have not overlooked any of the literature of this subject, it is now recorded for the first time from the African Continent.

"The Arabs know it as the *Abu-amma*. *Abu* means father, and *amma* blind; and I am informed that the two may be translated as meaning the truly or essentially blind. In the specimens sent round, the one in alcohol has the head intact, while in the other semi-dried specimen the skin has been reflected to exhibit the small eye, a mere black speck among the muscles, which Olivier states is perfectly organized, but I have not as yet examined it myself. It will be observed that the under surface of the reflected skin exhibits no trace of the remains of an eye-opening, and that the eye is separated from the skin proper by a thick layer of the skin-muscle, which I have partially dissected out. The presence of this muscular layer must exclude even the faintest sensation of light, so that, in time, all trace of an eye will probably be lost if the animal retains its present habit of using its head in burrowing, which is doubtless the cause of the disappearance externally of the delicate organ of sight. Of course its seemingly thoroughly underground habit of life also contributed its influence in dwarfing the eye. The first instinct of the animal when it is taken from its burrow and is let loose on the surface soil is to dig its head into the earth, the transverse ridge on the bare hard nose and the vibrissal ridge on the side of the head being special modifications of structure depending on this habit of life. This action of the large broad head is of course materially aided by the fore feet; but these structures are scarcely more developed than those of a common rat of the dimensions of itself, and the claws are only of moderate size.

"*Spalax* moves backwards in its burrows with remarkable ease, as I observed in one of the specimens captured; the reversible character of the fur and the reduction of the tail to a mere rudiment facilitate this movement.

"I had hoped to have shown to-night the animals I sent off alive from Egypt, but they all died on the way home, the last off the Isle of Wight. The person who was in charge of them informs me that they would probably all have reached this country alive had not the sandy earth that had been sent with them been impregnated with salt, which began to deliquesce as soon as the ship got into the moist atmosphere of the Mediterranean."

Prof. Romanes gave an account of some results recently obtained from the cross-breeding of Rats and Rabbits, and showed that according to these experiments it did not follow that a blending of the characters of the parents was always the result of crossing two different varieties.

Prof. Howes exhibited and made remarks on some photographs received from Prof. Parker, of Otago, New Zealand, illustrative of Sea-Lions, Penguins, and Albatrosses in their native haunts.

Dr. Dawson made some remarks on the Fur-Seal of Alaska, and exhibited a series of photographs illustrating the attitudes and mode of life of these animals.

Mr. Sclater called attention to the habits of a South-African Snake (*Dasypeltis scabra*), as exhibited by an example of this snake presented to the Society's Menagerie by Messrs. Herbert M. and Claude Beddington, of Port Elizabeth, and received September 15, 1891, which was placed on the table.

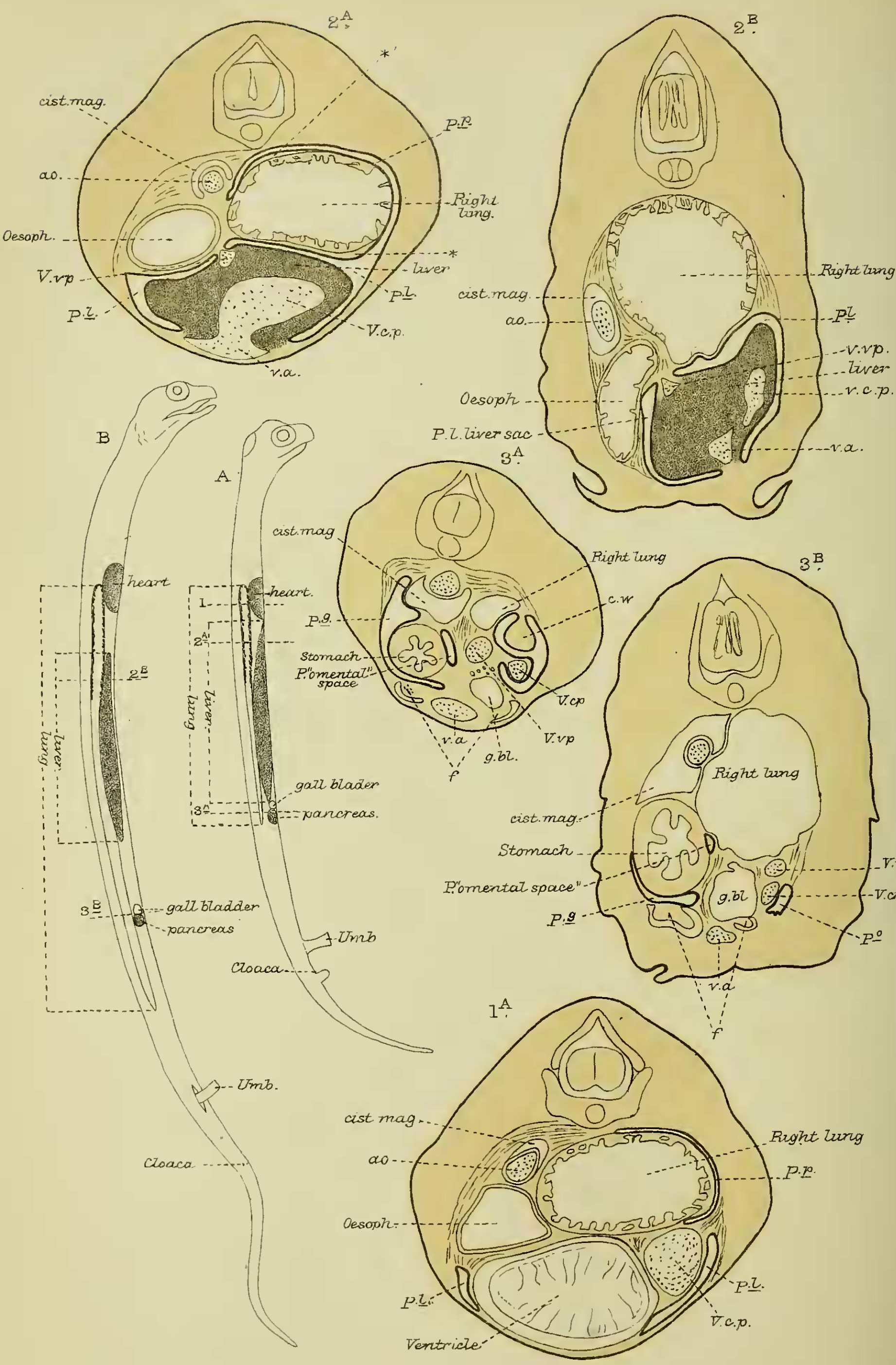
As was well known, this snake fed exclusively on eggs; and since it had been in the Society's Gardens it had occasionally eaten pigeons' eggs. These were, no doubt, pierced by the gular teeth which this peculiar snake possesses, and their contents emptied into the stomach.

A short time after the egg had been swallowed, the shell of the egg was rejected from the mouth in the form of a pellet.

Specimens of these pellets were exhibited [1].

[1] Dr. Andrew Smith writes as follows:—

"The paucity and smallness of the teeth in the mouth are favourable to the passage of the egg, and permit it to progress without injury, whereas were they otherwise, many eggs, which have very thin shells, would be broken before they entered the gullet, and the animal in consequence would be deprived of its natural food when within its reach. Having observed that living specimens which I kept in confinement always retained the egg stationary about two inches behind the head, and while in that position used great efforts to crush it, I killed one, and found the gular teeth at about the place where the egg ceases to descend. Those teeth, I am satisfied from many observations, assist in fixing the egg, and also in breaking the shell when the former reaches them, and is subjected to compression by the muscular action of the parts surrounding it. The instant the egg is broken by the exertions of the animal, the shell is ejected from the mouth, and the fluid contents are conveyed onwards to the stomach." ('Illustrations of Zoology of S. Africa,' text to plate 73.)



G.W. Butler ad nat. delt.
M.P. Parker chr. lith.

West, Newman imp.

Body-cavity of Snakes.

Mr. Sclater read some extracts from a letter addressed to him by Mr. H. H. Johnston, C.B., F.Z.S., dated the Residency, Zomba, British Central Africa, March 27th, 1892, announcing the despatch of a large consignment of Natural History specimens illustrative of the Fauna and Flora of the Shiré Highlands, a good proportion of which were from altitudes of from 4000 to 8000 feet on Mount Zomba and Mount Milanji. Mr. Johnston requested Mr. Sclater to place these specimens in the hands of competent naturalists for examination.

Mr. Sclater stated that one box containing 150 bird-skins and 6 mammal-skins had already arrived, and that he proposed to ask Mr. Oldfield Thomas to undertake the examination of the latter and Captain Shelley to determine the birds. The first complete set of everything was to be deposited in the British Museum.

Mr. W. Saville Kent, F.Z.S., exhibited and made remarks on some photographs of a species of the genus *Podargus* (*P. strigoides*), showing the strange attitudes of these birds in a living state.

Mr. J. W. Gregory, F.Z.S., gave an account of his researches on the British Paleogene Bryozoa, of which he recognized 30 species, represented in the National Collection by about 750 specimens.

This paper will be published entire in the Society's 'Transactions.'

The following papers were read :—

1. On the Subdivision of the Body-cavity in Snakes.

By Gerard W. Butler, B.A., F.Z.S.

[Received May 14, 1892.]

(Plate XXVIII.)

Contents.

§ I. *Introductory.*

This paper is a continuation of my previous one "On the Subdivision of the Body-cavity in Lizards, Crocodiles, and Birds" (Proc. Zool. Soc. 1889, p. 452). Probably most persons will admit that the comparative study of any structure is more or less useful, since any such study may at any time suggest or confirm relationships between different types, or may throw light on physiology. But whether there be much or little interest in the relations (in the different groups of the Amniota) of the pleuroperitoneal cavity, with its more or less complete subdivision into different spaces, by longitudinal, transverse, or oblique membranes or "diaphragms," the fact remains, that any departure from that which embryology shows to be the simplest arrangement (viz. that seen in Lizards) at once arrests the attention of the anatomist; and, accordingly, much is from time to time written on the subject.

Therefore, as the matter is one which cannot be satisfactorily discussed except after somewhat laborious work in embryology and comparative anatomy, I have thought it well, having once gone some length in the matter, to continue my investigations.

I have to thank the "British Association," the occupation of whose "table" at the Zoological Station at Naples in 1890 gave me facilities for the collection of various Reptilian material, embryological and otherwise, and also my former teacher Prof. G. B. Howes, of the Royal College of Science, South Kensington, who generously placed at my disposal a large variety of Snakes, with permission to work at them in his laboratory. I am also indebted to Mr. G. A. Boulenger, who has kindly identified many of my specimens.

§ II. *Bibliography.*

The writer in Bronn's 'Klassen u. Ordnungen des Thierreichs' (Band vi. Abth. 3, p. 1544) says:—"The peritoneum of the Python, and apparently of many exotic Snakes, exhibits peculiarities not known in any other vertebrates. These peculiarities have been often described, and always as something quite 'new'"; and he goes on to give references. It would appear, however, from the way he speaks, and the references he gives, that the "peculiarities" of which he is thinking consist simply in the relation of the peritoneum to the stomach and intestine, the individual coils of which latter it does not follow. And, such being the case, he is quite right in saying that they have often been described (at any rate from Meckel[1] downwards). But this is only one point about the peritoneum of Snakes, and not the most interesting one. While one of the authors to whom he refers us [namely Retzius, (1) & (2)] has noted all the other peculiarities, Duvernoy confines himself to the one point above mentioned, and Herring, who is quoted without adverse

[1] Deutsches Archiv für die Physiologie (Halle), Band iii. 1817, p. 219.

criticism, is absolutely incorrect and misleading when he says of the Boa constrictor, "*es ist kein Cavum* thoracis oder *abdominis vorhanden*. . . ."; for the peritoneal cavity ("cavum abdominis") with its various subdivisions, judging by a young specimen in the British Museum, which, by the courtesy of Mr. Boulenger, I was permitted to examine, is better seen in *Boa constrictor* than in most Snakes. It is, however, hardly surprising that anyone, not forewarned by allied studies, should err as to the peritoneum of these animals.

I shall notice the paper by Lataste and Blanchard presently.

We are also referred to F. Leydig ["Ueber die einheimischen Schlangen," Senckenberg. naturf. Gesellschaft, Band xiii. 1883–4]. Leydig, however, like the writer in the 'Thierreichs,' who is perhaps following him, quotes indiscriminately Herring, who is wrong, and Retzius who is right; and the conclusion which (*loc. cit.* p. 214) he says we may draw from the various descriptions (as to the coexistence of a peritoneal cavity and a subdivided lymph-space) is, as might be expected, vague, and does not convey a correct idea of the actual facts.

To one who has elsewhere found nothing but incomplete and usually very meagre and general, if not incorrect, accounts of the Ophidian peritoneum, it is a pleasure to turn to the account of Retzius (1) & (2).

This author in 1830 described the state of things in the *Python*, overlooking no division of the peritoneal cavity; though in the case of two of the smaller spaces he simply calls them "serous canals." His description of the peritoneum appears to be as complete as it is possible for such a description of the anatomical features of any one animal to be, without the light thrown by comparative anatomy and development. One small division of the peritoneal cavity, which embryology shows to be a remnant of the "omental" space, I did not myself discover in any adult Snake until after reading Retzius' account of the Python. But although this careful "old master" seems to have seen more than any one else since, I nevertheless hope that there will be something "new" in the following paper, in so far as a study of their mode of origin furnishes material for the discussion of the true nature and the homologies of the various peritoneal spaces, and in so far as a comparative study of examples of nearly all the families of Snakes enables me to state it as probable that most, if not all Snakes, while differing considerably in other respects, are essentially alike in their peritoneal cavities[1].

We come now to the papers by Lataste and Blanchard (3) and Blanchard (4). The statement on p. 95 of (3), to the effect that the peritoneum does not extend anteriorly to the gall-bladder, is qualified by one on p. 106, to the effect that there are two serous

[1] For instance, *Tupinambis* (*Tejus*) differs strikingly from other Lizards in the possession of a most distinct transverse septum behind the liver (see Proc. Zool. Soc. 1889, plate xlviii. and text). I have recently discovered a previous mention of this structure by Meckel [Deutsches Archiv für die Physiologie (Halle), Band iii. 1817, p. 218]. However, Meckel gave no figure or detailed description of this septum.

sacs in the region of the liver. These authors are chiefly concerned with details as to the most posterior of the spaces described in this paper, especially as to its tapering forward and backward extensions. Some of their statements were in 1880 questioned by S. Jourdain [1]; and in 1882 Blanchard, in the light of new material, published a second paper (4) in which he modifies the account given in the former (3) [2].

These authors refer us to Cuvier (1835), Duméril and Bibron (1844), Siebold and Stannius (1848), and Milne-Edwards. I have of course carefully consulted these and also Owen, Hunter (' Essays and Observations,' edited by Owen), and various modern text-books; but I have not found anything on this subject to which it is worth while to refer the reader. Anatomists have as a rule kept clear of it; and one feels that it would be often mere impertinence to criticise in detail the little that has been said. So far as my search has gone, while here and there we find details of truth often mixed with more or less error, it may be said, speaking generally, that those authors who are not betrayed into including Snakes under their description of other reptiles, keep safe, by confining themselves to the most meagre details or to the most vague and general statements. For instance, Cuvier (Leçons d'Anat. Comp. 2nd ed. 1835, tom. iv. 2e part. pp. 670, 671) describes the relations of the pleuro-peritoneum in the Slowworm (*Anguis fragilis*), where we have the typical Lacertilian condition, and adds that in the true Snakes things are similar, *but more complicated*. In the paper above referred to (3) Lataste and Blanchard do an injustice to Cuvier by quoting this passage without the last " saving clause."

List of Titles.

[Snakes.]

(1) Retzius.—" Anatomisk untersöckning öfver nägra delar af *Python bivittatus*." Kon. Vet.-Akad. Handl. Stockholm, 1830, pp. 81–116.

(2) Retzius.—[German version of the above]. " Isis," Leipzig, 1832, pp. 511–531.

(3) F. Lataste et R. Blanchard.—" Le Péritoine du Python de Seba." Bull. Soc. Zool. de France, 1879, pp. 95–112.

(4) R. Blanchard.—" Nouvelles recherches sur le Péritoine du Python de Seba." Bull. Soc. Zool. de France, 1882.

[1] Revue Internationale des Sciences, 1880, p. 267.

[2] What chiefly interests these writers is a *macroscopic* connection which they find between the hinder division of the peritoneal cavity and the connective tissue in that region, and so possibly with the "cisterna magna" (grande cisterne rétro-péritonale), and they add suggestive remarks as to the relations of cœlom, lymph-spaces, and connective tissue in general, and the interchangeability of the two latter. There is, as they say, nothing essentially new involved, but it would be interesting, if their account be correct (but this is disputed), to see with the naked eye what is in other animals only to be seen with the microscope.

[Lizards, Crocodiles, and Birds.]

(5) "On the Subdivision of the Body-cavity in Lizards, Crocodiles, and Birds."[1] Proc. Zool. Soc. London, 1889, pp. 452–474, plates xlvi.–xlix.

I quote this paper here because, as explained, the present one is really a continuation of it, and I shall have occasion to refer back to it. Some other references will be found in it.

§ III. *List of Snakes examined*[2].

Suborder I. **OPOTERODONTA.**					
Fam. CATODONTA.		....	...		
Fam. EPANODONTA.		*Typhlops lumbricalis* ...	*a*	I	
Suborder II. **COLUBRIFORMIA.**					
Fam. UROPELTIDÆ.		*Rhinophis blythii*	*c*		
Fam. TORTRICIDÆ.		*Cylindrophis rufa*	*c*		
Fam. XENOPELTIDÆ.		*Xenopeltis unicolor*......	*a*		
Fam. PYTHONIDÆ.	ERYCINÆ.	*Eryx johnii*	*a*		
	BOINÆ.	*Enygrus carinatus*	*a*		
		Boa constrictor	*a*		
	PYTHONINÆ.	*Python molurus*	*a*		
Fam. CALAMARIDÆ.		*Aspidura trachyprocta* .	*b*		
Fam. COLUBRIDÆ.	CORONELLINÆ.	*Liophis meremii*	*a*		
	NATRICINÆ.	*Tropidonotus natrix*	*b*	‡	
		Heterodon d'orbignii ...	*b*		
	COLUBRINÆ.	*Elaphis quadrilineatus* .	*b*	‡	
		Composoma melanurum.	*a*		
		Zamenis gemonensis ...	*b*	*	
		Pituophis catenifer ...	*b*	*	

[1] I take this opportunity to make the following corrections and additions:—

P. 464, l. 14, for "*Vitelline*" read *Allantoic*.

P. 473, l. 14, for "*mesentery and ligaments*" read *mesentery and median ligaments*.

Fig. 7, erase *v.om*, *v.om'*.

Fig. 33, for 4 read 3.

Fig. 46, the space on the right side of the figure into which the spleen and œsophagus project should be marked 2′ and similarly

Fig. 47, for 2 and 3 read 2′ and 3 (on the left side of the figure).

With regard to figs. 42 and 43 see below, § VII. (iii.) note.

Further, since the description of the Crocodile was written, I have, thanks to the generosity of Mr. S. F. Clark, of Williams College, Mass., been able to cut sections of a considerably younger stage (viz. a 35-days Alligator). This, while confirming the other opinions expressed in the previous paper, makes it clear that there is originally a "Foramen of Winslow" in the normal position, so that from the 7th to the 18th lines inclusive on page 470 of (5) should be struck out.

Lastly, since p. 465 of that paper was written, I have found that certain Scincoid Lizards are as to the relations of their right lungs and liver intermediate between the Teiidæ and other Lizards; while *Acontias meleagris* agrees with most Lizards, *Anguis fragilis*, *Chalcides mionecton*, and apparently *Acontias monodactyla* have their "pulmohepatic recess" not extending into the region of the lungs. So that a section through the lungs resembles fig. B on that page, and one behind the lungs shows the right lobe of the liver attached as in fig. A.

[2] For explanation see § V.

Suborder **COLUBRIFORMIA** (*continued*).			
Dryadinæ.	....	...	
Fam. DENDROPHIDÆ.	*Dendrophis picta*	*a*	
Fam. DRYOPHIDÆ.	*Dryophis prasina*	*c*	2
Fam. PSAMMOPHIDÆ.	*Cœlopeltis lacertina* ...	*b*	
Fam. DIPSADIDÆ.	*Dipsas ceylonensis*	*c*	†
	Leptodeira rufescens ...	*c*	
Fam. SCYTALIDÆ.	....	...	
Fam. LYCODONTIDÆ.	*Lamprophis rufescens*...	*b*	3*
Fam. ACROCHORDIDÆ.	....	...	
Suborder III. **PROTEROGLYPHA.**			
Fam. ELAPIDÆ.	*Elaps fulvius*	*b*	
Fam. HYDROPHIDÆ.	*Hydrophis fasciata*	*c*	††‡
	Pelamis bicolor	*c*	
Suborder IV. **SOLENOGLYPHA.**			
Fam. VIPERIDÆ.	*Vipera berus*	*b*	
	,, *aspis*	*b*	
	,, *arietans*	*b*	*
	,, *nasicornis*	*b*	4
Fam. CROTALIDÆ.	*Crotalus durissus*........	*b*	

§ IV. *On the Subdivision of the Body-cavity in the Adult Snake.*

(0). *Preliminary, and as to certain Extra-peritoneal Lymph-spaces.*

Once one knows what to look for and where to find it, it is not difficult to make out the relations of the peritoneum in Snakes of ordinary size, such as the Common Grass-Snake (*Tropidonotus natrix*) or the Common Viper (*Vipera berus*). But without such knowledge it is, judging by my own experience, not so easy.

I may perhaps be excused then if, in describing what is seen, I explain how to find it. I have spoken simply of the peritoneum, because, as may with advantage be stated here, the pleural cavity or cavities appear to be obliterated in all the Snakes I have examined [this will be discussed later, § VI.]. All my specimens have been more or less hardened in spirits, and it would seem that sometimes specimens which on the outside appear unduly soft are well adapted to our present purpose.

To dissect a Snake, insert scissors between the skin and the ribs, and cut all along the body from the region of the heart to the cloaca, keeping rather to one side of the mid-ventral line, with the scissor-points close under the skin. Having then turned back the skin from the ventral side of the animal, nothing is simpler than to ease away outwards on each side the ribs and the muscles of the body-wall, so far as they close in the ventral side. We then see, stretching from about the hinder end of the liver to not far from the cloaca, the well-known *fat-bodies*, sheathed ventrally by membranous tissue, which laterally wraps round outside all the viscera including the kidneys.

Now, first, as to these fat-bodies. If the Snake under examination be a *Python* or a *Cylindrophis rufa* (and I think I might add the water-snakes *Hydrophis* and *Pelamis*), one possible source of error is eliminated, for in these there is no space round the fat, such as is present in the great majority of Snakes. In *Python* the fat occurs as a number of small separate lobules, quilted between membranous tissue, and the condition is somewhat similar in *Cylindrophis*, though anteriorly the fat-lobules tend to run together.

On the other hand, in most Snakes the fat occurs as a continuous, but often much folded band on either side, each of which hangs in a well-marked lymph-cavity [1] which might perhaps be taken, as it has been taken in certain other Reptiles, for a part of the cœlom proper. Development, however, shows that this is not the case. The fat and the space round it become differentiated at a comparatively late embryonic stage, and the space probably arises in the same way as, and should be placed in the same category with, the "cisterna magna," in which runs the aorta [2]. This latter is, like the circum-adiposal lymph-spaces, well developed in Snakes. Besides these there may be a more or less distinct lymph-space round the kidneys.

It would have been impossible, in discussing the body-cavity proper of Snakes, to omit a reference to these *extra*-peritoneal lymph-spaces, for they are certain to strike the observer, and may be in some cases more conspicuous than the peritoneal cavity itself; and he might possibly take them for part of this and wonder why no reference had been made to them. For further remarks on these spaces, and figures showing their relations in adult *Tropidonotus* and *Vipera* and advanced embryo of *Tropidonotus*, see paper "On the Relations of the Fat-bodies of the Sauropsida." [3]

After opening the ventral body-wall of the Snake as described above, it will be best, before further dissecting, to ascertain the position of the right and most anteriorly situated kidney. If, then, we cut through the membrane ventrad of the fat a little to the right side of the animal, we, as explained above, in nearly all Snakes cut into the right circumadiposal space; this can be followed forwards and backwards, as a continuous space from one end of the fat to the other. If we next, turning up the fat, cut through the inner membranous wall of this space at a point just anterior to the right kidney [4] we shall have cut into :—

§ IV. (i.). *The Single Posterior Peritoneal Space.*

This is described by Retzius, (1) p. 91, (2) p. 517, and Lataste

[1] In certain other Snakes we see a condition of things intermediate between this and what obtains in Pythons—in fact, we have an interesting and possibly suggestive series, which need not, however, be discussed here.

[2] Thus in advanced *Elaphis* embryos (Plate XXVIII. figs. A, B) the allantoic arteries run forwards from the aorta to the umbilical stalk in the posterior part of these circumadiposal lymph-spaces, as the aorta runs in the cisterna magna, but there does not appear to be any communication between these spaces.

[3] Proc. Zool. Soc. London, 1889, plate lix. figs. 8, 9, 10. [N.B. *g* in fig. 9 and *re* in figs. 5 and 6 should be *c.w.*]

[4] If we cut at random we shall possibly miss the peritoneal cavity altogether, and may perhaps cut either into the "cisterna magna," or a lymph-space that may surround the kidney.

and Blanchard (3). If we carefully, with the aid of a seeker and pair of scissors, open up the ventral wall of this space, we shall find that it tapers off posteriorly on the ventral side of the rectum and appears to end at a small distance in front of the cloaca (varying in different species). On the other hand, we find that it ends anteriorly in front of the reproductive glands. It is in fact, like the corresponding space in Birds, Crocodiles, and *Tupinambis*, an *intestino-genital* cavity.

As the right reproductive gland lies, in Snakes, in advance of the left, this posterior peritoneal space extends forwards farther on the right side than on the other.

In the male we shall probably have no difficulty in making out the anterior limits of this space, just in front of the anteriorly rounded testes.

But in the female it may not be always easy to say exactly where this space does end anteriorly. If we follow the oviduct of either side forwards, we find the anterior end of its funnel continued as a thread into a narrow, forwardly directed, funnel of peritoneum. On the right side [*cf.* (3) pp. 100, 101] this narrow peritoneal funnel or tube runs forwards just externally to the portal and postcaval veins, and is the remnant, as will be explained later, of the right half of the peritoneal cavity in this region, which, down to a comparatively late embryonic stage, persists as a narrow tube (fig. 3^{B}, P^{o}) placing the posterior peritoneal space now described in communication with that in which the right lobe of the liver lies. Similarly with the small funnel on the left side. We can frequently tell approximately where these peritoneal tubes or funnels end, and this was especially clear in a specimen of *Heterodon d'orbignii.* While sometimes it is hard to say this, it is not very important to know the exact point at which such tapering tubes end, especially as it is, in nearly all cases, perfectly clear that the anterior peritoneal spaces into which they might be expected to lead are closed behind [1]. The wonder is not that where, as in the females, these forwardly directed peritoneal funnels occur they should vary as to their extension forwards, but that the original embryonic continuity of the peritoneal cavity on either side is, so far as I can ascertain, never maintained in the adult.

Before leaving this hindmost division of the peritoneal cavity, which, as stated, extends in the male (and except for insignificant tubular processes in the female also) from the anterior border of the reproductive organs to a point on the rectum usually not far from the cloaca, it may be well to say a few words as to the viscera which project into it.

As stated in § II., the relations of the peritoneum to the alimentary canal have been repeatedly noticed by writers on Snakes, from Meckel (*loc. cit.*) to the present day (*cf.* for instance Rolleston,

[1] It is only rarely that the right half of the liver tapers off backwards along the course of the posterior vena cava. When this is so, it may be sometimes difficult to say exactly where the tapering liver-sac ends. [*Liophis meremii, Vipera arietans, V. nasicornis, Crotalus durissus.*]

'Forms of Animal Life,' 2nd ed. p. 69). From my tabulated notes I find that the straight terminal portion of the intestine seldom projects at all into the body-cavity, and that the less folded portion, immediately preceding this, seldom (as in *Cœlopeltis lacertina*, *Crotalus durissus*, *Compsosoma melanurum*, and *Python*) has anything that can be called a mesentery. As to the zigzag part of the intestine that follows the stomach, the peritoneum (as so often noticed) does not follow the individual bends, but merely covers the zigzag as a whole. In fact *the intestine of Snakes, as a rule, intrudes upon the peritoneal cavity less than in any other Vertebrates.*

Secondly, as to the kidneys [1]. With rare exceptions, the permanent kidneys in Sauropsida (unlike the Wolffian bodies of the embryo, and the kidneys of certain Mammalia) do not project freely into the body-cavity, but are in great part, if not entirely, situated outside it [2]. Snakes are no exception to this rule. In *Boa constrictor*, it is true, I have found the kidneys hanging freely in the body-cavity, as in certain Amphisbænidæ, but this is the only case I have found among Snakes. The only other Snakes in which I have found any part of the kidneys projecting into the body-cavity are *Typhlops*, *Cœlopeltis*, and the *Pythonidœ*, and in these cases the intrusion is but slight. In all the other forms examined (see list § III.) [3] *the kidneys lie entirely outside the peritoneal cavity, and do not project at all into it.* It is interesting to note that this exclusion of the kidneys from the body-cavity in Snakes is, like the absence of this cavity round parts of the alimentary canal, not primary. That is to say, when, at a comparatively late embryonic stage, the permanent kidneys first begin to develop, they in part project into the peritoneal cavity, as is the case in the adults of some (and perhaps most) Lizards.

Thirdly, the only other organs whose relations to this hinder peritoneal space we have to consider are the reproductive ones; and these in both sexes (and as I believe to be the case in all Vertebrates) project freely into the body-cavity.

Bearing, then, in mind that the kidneys of Snakes are with rare exceptions wholly outside the peritoneal cavity [4], and that the intestine commonly has no mesentery and bulges but little into the body-cavity, so as in individuals of some species (*Liophis meremii*) to appear to have almost entirely receded from it, it will be readily understood that *this hinder peritoneal space may occasionally be reduced in Snakes to little more than a tube containing the*

[1] I add these remarks as to the kidneys because those organs are usually referred to in discussing the relations of the peritoneum, and the impression is sometimes conveyed that there is something unusual in the exclusion of the kidneys from the body-cavity.

[2] The Amphisbænidæ [e. g. *A. darwinii*, *Lepidosternon scutigerum*, and to a rather less extent *A. alba* and *Pachycalamus brevis*] are the only marked exceptions I know of besides the *Boa constrictor*.

[3] I could not ascertain the relations in *Lamprophys*, *Hydrophis*, and *Crotalus*, but have no reason to suspect them to be exceptional.

[4] The lymph-space mentioned above which may occur round them must not be mistaken for part of the peritoneal cavity.

reproductive glands and their ducts. From this it is not surprising to find that it terminates anteriorly in front of the reproductive organs, the body-cavity of either side being obliterated over a longer or shorter area.

§ IV. (ii.). *The Unpaired* "Gastric" *Peritoneal Space of the Left Side.*

Between the hinder end of the right liver-lobe and the anterior end of the right reproductive gland the main[1] *right* half of the peritoneal cavity is unrepresented in the male; and in the female it is only represented (as described above) by a narrow peritoneal funnel or tube which sometimes extends but little in advance of the ovary.

On the other hand, on the *left* side there is, with few exceptions, a distinct peritoneal space to be made out in the pyloric region. Retzius [(1) p. 89, and (2) p. 515], describing *Python bivittatus*, notices both this and the space which will be later referred to [§ IV. (iv.)] as the omental one.

To find this *gastric space* in any Snake, we, after the preliminary easing away of the body-wall described above (§ IV. (0)), mark the point at the end of the stomach where, about opposite the hind end of the gall-bladder, it is often slightly bent (just where its thick-walled part ends). Then, carefully lifting up and cutting through the membranous tissue that wraps round the left and ventral sides of the posterior end of the stomach, we shall in nearly all cases (*see* § III. and § V.) find a distinct serous space, which, in the region described, wraps round the stomach on its ventral and left sides (the "blind sac" of Retzius); when, as sometimes happens, this is continued forwards by a narrow canal ("left serous canal" of Retzius), this latter, as a rule, lies more ventrally than laterally to the stomach itself.

This *gastric sac* was, among the forms I examined, best developed in a specimen of *Cœlopeltis lacertina*, where it extended from a point $1\frac{1}{2}$ inches behind the gall-bladder forwards, so as to slightly overlap the left liver-lobe. It is, however, here, as apparently in all Snakes, divided off from the peritoneal sac that surrounds that liver-lobe. It is also well developed in some specimens of *Zamenis gemonensis* (a common Italian Snake) and in the various types of Pythonidæ examined (viz. *Eryx*, *Enygrus*, *Python*). It was also distinct in *Compsosoma* and *Lamprophis*; and in fact I ascertained its presence in all the species examined, with the exception of a few marked (*c*) on the list in § III., and it not improbably occurs in some of these also.

However, it is developed to a very different degree in different species and in different individuals of the same species. Thus *it will very likely not be found in many specimens of* Tropidonotus natrix, *while it would appear* (Elaphis, Zamenis) *that it may be larger in the male than in the female.*

[1] There is, however, in many cases, a more or less marked "omental" space traceable (*cf.* § IV.).

As might be expected, when this "gastric" sac is reduced in extent, what remains of it will be found at the point where it is most expanded in other cases: that is, at that point approximate to the posterior end of the stomach, where I have suggested above that search for it should be made.

§ IV. (iii.). *The Paired Peritoneal Liver-sacs.*

Some writers make a point of the liver of Snakes being unilobular. This is in a sense true, in so far as, with the exception of the oft-quoted liver of *Typhlops* [in which animal there are some three principal, besides minor, lobulations of the liver on each side], and the trifling lobulation that may be seen in some other cases (*Vipera berus* and *arietans*), the liver of Snakes presents at first sight the appearance of one elongated body.

However, *morphologically, no animal has a more obviously bilobed liver.* And it is most certainly incorrect to say, in the language of one of our text-books, that the liver of Snakes corresponds only to the right liver-lobe of other Reptiles.

As Retzius remarks of the Python [(1) p. 96, (2) p. 520], *the liver is divided "into a right and left half . . . each lateral half of the liver is enclosed in a serous capsule of its own."*

It need perhaps hardly be added that the dorsal and ventral lines of demarcation between the two halves of the liver really represent the lines along which that organ meets the median longitudinal septum, which in its dorsal part supports the œsophagus and which, in all air-breathers, divides the pulmohepatic part of the pleuroperitoneal cavity into right and left halves [1]. We shall return later, § VII., to these liver-sacs, so that little need be said of them here. They fit the liver-lobes pretty closely, and therefore cannot possibly be missed even in the smallest Snakes.

In the rare cases in which the right liver-lobe tapers off along the course of the posterior vena cava (*Liophis meremii*, *Vipera arietans* and *nasicornis*, and *Crotalus durissus*), the liver-sac of that side necessarily does so too, wherefore it is hard to ascertain exactly where it ends.

§ IV. (iv.). *The Unpaired "Omental" or "Lesser Peritoneal" Space of the Right Side* [2].

This space is practically the most difficult of any of the peritoneal spaces to find. Moreover, I do not think that it is present in the

[1] Owing to the marked tilting of the liver over to the right side in Snakes, while the right, and usually only, lung often takes up a position in the mid-dorsal line, what is morphologically the median sagittal plane of the Snake, so far as the cœlom and viscera are concerned, usually, in the region of the liver, makes an angle (varying from 45° [*cf.* Plate XXVIII. fig. 2 B] to 90°) with the plane joining the vertebral column with the middle of the ventral scales.

[2] The space referred to occurs apparently in all the Amniota, and it is, I

adults of all Snakes; and this, not merely because I have not in a number of cases been able to satisfy myself as to its presence by dissection, but also because in *Elaphis quadrilineatus*, of which I obtained some advanced embryos, I find, by serial sections, that it is almost totally obliterated while still within the egg.

If this space is present, one may expect to find it as a small one immediately on the right side of the stomach, and especially of the hinder part thereof—in fact, *lying between the gall-bladder and the stomach and bounded behind by the pancreas*. It will not in any case extend caudad of the pancreas, and it may not reach quite so far back as the anterior end of that organ in the adult. Anteriorly it may, when specially well developed, extend forwards as a narrow space on the right side of the stomach to a point a little anterior to the posterior end of the right liver-lobe (*Typhlops lumbricalis*). This omental space, in the Snakes which I have examined, is best seen in *Typhlops*, *Xenopeltis*, and the Pythonidæ; it is also well marked, though in a less degree conspicuous, in *Compsosoma*, *Dendrophis*, and others. I could not distinctly make it out in the forms marked (*b*) and (*c*) in the list (p. 489).

This "omental" space must not be confused with the "gastric" space above described, which runs close to it but more to the left side; that, in its hinder region, usually distinctly wraps round the left side of the pyloric part of the stomach, while this omental space is on its right side.

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believe, disguised, by the fenestration of the mesogastric and gastrohepatic ligaments, in the Amphibia also.

The word "*omental*" is somewhat ambiguous, and "*lesser peritoneal cavity*," though excellent for the Mammalia, is unsatisfactory in the case of Birds, Crocodiles, and Snakes, where there is more than one such cavity present.

It may be explained, then, that the term "omental space" is here used to include the whole space that corresponds to (*a*) the "Saccus omenti" of Mammals (the sac enclosed by the recurved stomach and its attached membranes), and (*b*) the "Recessus superior sacci omenti" of His, which in embryos of Mammals extends forwards into the pulmonary region, and is the *right* "pulmohepatic recess" of my previous paper (5). In Lizards, Crocodiles, and Birds this "recess" may be more important than the "saccus" itself.

In the adults of most Lizards, of certain Chelonians (*Thalassochelys*), and at any rate of certain Mammals, and in the embryonic stages of Crocodiles, Snakes, and Birds, we find that this "omental space" communicates with the right side of the peritoneal cavity by an aperture (very wide in many Lizards) which is the "Foramen of Winslow." This "Foramen of Winslow" is bounded postero-ventrally by the pancreas and the hepatic ducts, which run in the hinder margin of the gastro-hepatic ligament, and antero-dorsally by the posterior vena cava, which, in its course from the kidneys (or in an embryo from the Wolffian bodies) to the liver, runs in what either is, or once was, the posterior margin of a ligament attaching the right half of the liver to the dorsal body-wall.

This "Foramen of Winslow" may persist as described, as in most Lizards and some Chelonians (*Thalassochelys*) and Mammals; or it may become obliterated, as in Amphisbænians, certain Chelonians (*Testudo* and *Emys*), Snakes, Crocodiles, and Birds (*Gallus*).

In the latter case we have, as a result, an entirely closed peritoneal sac.

§ V. *Explanation of the List of Snakes given in* § III.

a—signifies a Snake in which I have clearly found the full complement of peritoneal spaces as described above, § IV., viz.:—

α. The posterior peritoneal space.
β. The paired liver-sacs.
γ. The gastric sac of left side.
δ. The "omental" space.

b—signifies a Snake in which I have not clearly made out the "omental" space, though all the others occur;

but * indicates that this *probably* is present.
,, ‡ ,, ,, *possibly* ,,

c—signifies a Snake in which I have not clearly made out either of the smaller peritoneal spaces, *i. e.* either the "gastric" or the "omental," though the principal sacs, viz. the two liver-sacs and the posterior peritoneal space, occur.

† indicates that a Snake *probably* has a "gastric" sac.
†† ,, ,, ,, *possibly* ,, ,, ,,

1—*Typhlops*.—In this the anterior and posterior boundaries of the gastric sac were not clearly made out.

2—*Dryophis* (one of the long "Whip Snakes").—I cannot pretend to have seen the posterior boundary of the liver-sacs, but have no reason to believe that they are not closed as in all other cases.

3—*Lamprophis*.—It is possible that the right testis is enclosed in a separate peritoneal sac apart from the posterior peritoneal space. If so, this would be a peculiarity of this Snake.

4—*Vipera nasicornis*.—I am not sure that the gastric sac does not communicate with the posterior peritoneal space. If it does, we merely have a persistence of a condition of things which (*see* § VI.) certainly does persist to a comparatively late embryonic stage.

The list in § III. in part speaks for itself. I may point out, however, that *Snakes marked* b *and* c *are essentially similar as to the relations of their peritoneum to those marked* a. The "gastric" and still more the "omental" space is as a rule small, and anyone who did not know exactly where to look for either would in most cases not find them. Where there was no clear indication of one or both, I have marked the Snakes *b* or *c* as explained; and it is quite possible that one or both of them may be found in Snakes so marked. Moreover, even if they are absent this does not indicate any hard-and-fast dissimilarity between the Snakes marked *b* and *c* and those marked *a*, for development (§ VI.) shows that both the "gastric" and the "omental" spaces are, with rare exceptions, but reduced remnants of original more extensive ones; and a comparative study of the Snakes on the list shows that when these spaces are present, the amount of reduction of either varies very greatly, not only in different species but in different individuals of the same species. It is not then surprising, but, rather, just what we should expect, that in some cases one or both of these spaces should have become obliterated altogether.

§ VI. *The Developmental History of the Pleuroperitoneal Cavity of Snakes.*

At first sight the aspect of a Snake embryo is perhaps forbidding to the embryologist [1]. During much of its early existence great part of such a Snake is coiled round its allantoic stalk in such a way that it cannot be uncoiled, and one may have to do with the same embryo cut through nine times in one section. On the other hand, in later stages, when the embryo can be straightened out, it is apt to be desperately long. However, the part of the animal which chiefly concerns us in the earlier stages is not affected by the coiling, and though the modifications which produce the characteristic relations of the peritoneum of the adult Snake only arise at a comparatively late embryonic stage, one comes to the end of even a six-inch Snake sooner than might be expected, especially when, as in the present case, it is not necessary that the sections should be very thin.

§ VI. (i.). *Early Embryos of* Tropidonotus, Zamenis, *and* Vipera (with gill-slits).

For the earlier stages (about period II. of Rathke [2]), I obtained a series of embryos of *Tropidonotus natrix*, and a less complete one of *Zamenis gemonensis* and *Vipera aspis*. These stages extend from (i) a time, soon after the first appearance of the allantois, when there were traces of but one or two postoral clefts and the spiral coiling had not begun, to (ii) a time when there were 4 complete coils in the abdomino-caudal region, and when, though the gills were hardly so apparent as in a stage with only 3 coils, sections showed that there were here, as in that stage, 4 pairs of postoral gill-pouches, the first two of which communicated with the exterior.

In the most advanced of these earlier stages the pleuroperitoneal cavity presents a condition of things similar to that which we find in Lizards. That is to say, besides the main pleuroperitoneal cavity continuous throughout its whole extent, we have to the right of the stomach a "lesser peritoneal" or "omental" cavity, communicating with the right half of the main pleuroperitoneal one by a "Foramen of Winslow."

The omental sac proper is, however, very small. Its anterior recess ["Recessus superior sacci omenti" of His—my "pulmo-hepatic recess" (5)], which, in Birds, Crocodiles, Chelonia, and most Lizards, runs forwards between, and is bounded by, the œsophagus and the lung and liver-lobe of the right side, and their connecting ligaments), in these Snake embryos, as in certain Scincoid Lizards [3],

[1] On the supposition that he desires to obtain a complete series of sections. Doubtless much can be done without this, but in dealing with a subject like that before us, when microscopic spaces have to be traced and it is often desirable to be able to prove a negative—to prove, for instance, that two small spaces do *not* communicate—no other method is equally satisfactory.

[2] Rathke, 'Entwick. d. Natter,' Königsberg, 1839.

[3] *Anguis fragilis, Chalcides mionecton*, and apparently *Acontias monodactyla*. However, *Acontias meleagris* presents the condition of things that is usual in

does not extend forwards into the region of the lung [1]; it is confined to the hepatic region—the pancreas, which forms the posterior wall of the space, being, together with the gall-bladder, at this stage and for some time longer in contact with the liver. But as development proceeds, and as the lung extends back to and beyond the hinder end of the liver, and as the pancreas and gall-bladder come to lie, as they almost invariably do in Snakes, a considerable distance behind the liver [2], this space (if not obliterated) comes to be, with rare exceptions, entirely posthepatic in position.

§ VI. (ii.). *Embryos of* Elaphis quadrilineatus, 11 *cm. long.*

The next stage that I have, an *Elaphis* embryo 11 cm. long (Plate XXVIII. fig. A), (all allowance being made for *Elaphis* being a larger Snake than *Tropidonotus* or *Zamenis*, with larger eggs), is considerably more advanced than the stage just described, and yet for our present purpose there is no important gap between them. There is in fact, as far as the pleuroperitoneal cavity is concerned, at first sight as yet nothing to suggest the characteristic Ophidian condition. The liver-lobe of either side and the lung for the greater part of its length project freely into the common pleuroperitoneal cavity.

The only definite change that we have to note is the closing of the "Foramen of Winslow"; this, however, not only occurs in Birds (*Gallus*), Crocodiles, and many Chelonians, but also in the snake-like but truly lacertilian Amphisbænidæ. In fact *an Elaphis embryo of* 11 *cm. long is still lacertilian as to its pleuroperitoneal cavity; but, nevertheless, the changes that are shortly to supervene are foreshadowed.*

Lizards, and perhaps little importance is to be attached to the difference. Whichever is the more primitive state of things, the one may easily be derived from the other. The condition in Snakes and the Scincoids first mentioned is probably associated with the elongation of form, and with the origin of the liver at some distance behind the point of origin of the lungs. In fact, in these Lizards, as in all the Snakes I have examined (with the exception of the species of *Vipera*, *Hydrophis*, *Pelamis*, and less markedly of *Typhlops*), there is even in the adult a distinct gap between the anterior end of the liver and the heart.

[1] Some of the Snakes examined (*see* list, p. 481), viz. the Pythonidæ (*Eryx*, *Enygrus*, *Python*) and *Xenopeltis*, have two well-developed lungs, the right, however, being the larger. Others, viz. *Rhinophis*, *Cylindrophis*, *Aspidura*, *Elaps*, have a more or less distinct rudiment of a left lung. Others again—*Tropidonotus*, *Elaphis*, *Dipsas*—have the merest trace of this, only to be found by careful search near the posterior corner of the heart. In some, again, *Vipera* (*berus* and *aspis*), *Crotalus*, *Lamprophis*, and others, I did not find any trace of a left lung. In *Vipera aspis* I find no trace of a left lung even in early embryos. Though I have no embryonic stages of the Pythonidæ or Xenopeltidæ, a comparison of their anatomy with that of the more usual one-lunged forms seems to assure us that, for our present purpose, there is no noteworthy difference between them. The left lung, when present, lies between the dorso-lateral wall of the left liver-sac and the œsophagus, in a position, in fact, corresponding to that of the right lung of the other side, and has not, any more than its fellow, any trace of pleural cavity round it.

[2] However, in *Rhinophis* and certain specimens of *Aspidura* the gall-bladder is close to the liver, and it is not far removed in the Common Viper (*Vipera berus*).

Thus, considering the relations of the lung to the body-cavity, we find that in the region anterior to the liver the cavity is reduced; and, *tracing our sections backwards*, we find that the anterior part of the lung is surrounded on all sides by connective tissue. Then (still in the region of the heart) a small cavity appears on the outer side of the lung, which (P^p in fig. 1^A), as we approach the apex of the heart and the anterior border of the liver, extends round dorsad of that organ. In sections that pass through the anterior apex of the liver, the lung is bounded ventrally by a sort of incipient fibrous-tissue "diaphragm," referable in part to a latero-anterior ligament of the liver, and in part to a proliferation of connective tissue that occurs on the ventral side of the lung, which we can trace extending backwards over the ventral surface of its at present free portion (* in fig. 2^A).

As remarked above, transverse sections taken anywhere else through the liver show the lung projecting freely into the common pleuro-peritoneal cavity, which wraps round it dorsally and ventrally, in fact all round it, except on its left or mesial side where it is attached (fig. 2^A). When, however, we follow the sections still farther back, behind the liver, we find that the posterior part of the lung burrows as it were into the connective tissue dorsad of the body-cavity, a little to the right of the aorta (fig. 3^A).

We see, then, that at both ends there is a tendency to exclude the lung from the general body-cavity, and at the same time to obliterate the pleural cavity. Similarly, if, leaving the lung, we turn to the left side of this embryo and follow the sections backwards, we find that it is not till we reach about the middle of the liver that we see the œsophagus projecting into the peritoneal cavity. For the anterior part of its course it is for the most part surrounded by connective tissue (figs. 1^A and 2^A).

Again; on the same left side of the body, just posterior to the left lobe of the liver, we find a foreshadowing of the "posthepatic septum," which later closes the liver-sacs posteriorly. This foreshadowing consists in a broadening and leftward extension over the stomach of the median ventral ligament. We note also that behind the liver the body-cavity of either side is somewhat circumscribed (fig. 3^A).

§ VI. (iii.). *Embryo of* Elaphis quadrilineatus, 15 *cm. long.*

My next stage is an *Elaphis* embryo 15 cm. long (Plate XXVIII. fig. B). I regret not having a stage intermediate between this and the preceding, or any embryo of another species of equivalent age. Still, I think that a careful comparison of the 11 cm. and 15 cm. stages leaves but little uncertainty as to how we ought to regard these peritoneal spaces of Snakes.

Comparing the general features of the two embryos, we see that the head has now a less embryonic appearance, the lower jaw, for instance, being better developed. The umbilicus is further removed from the cloaca, and sections show us that the gall-bladder and pancreas have become separated from the liver, and that the lung has grown a considerable distance backwards. In fact, an embryo of this stage, but for its comparative stoutness and the persistence of the Wolffian bodies in front of the kidneys, is very similar to the adult in the proportion of its parts and the position of the viscera. It is curious that the liver does not seem to have grown in length proportionate to the rest of the body.

Turning now to the condition of the body-cavity, we find that in the *Elaphis* embryo, 15 cm. long, the lung has become entirely excluded from that cavity, or, rather, *that part of the body-cavity which in the* 11 *cm. stage extended round the outer and dorsal walls of the lung has been entirely obliterated* (figs. 2^B, 3^B). Remembering, however, that in the 11 cm. stage it was only the part of the lung in the region of the liver (at that time the greater part of the lung) which projected freely into the body-cavity, it will not surprise us so much as it might otherwise do to find that no part of the lung is now surrounded by that space.

It will be remembered that, anterior to the liver, the pleural portion of the cœlom was in the preceding stage already in great part obliterated (fig. 1^A); and, judging by the relations of the posterior end of the lung at that time (fig. 3^A), it is but natural to conclude that the great length of lung which now extends behind the liver (*cf.* figs. B and 3^B) has developed where we find it, by burrowing backwards as it were in the fibrous tissue dorsad of the peritoneal cavity. We have, then, only to account for the exclusion from the body-cavity of that part of the lung which lies in the hepatic region (compare figs. 2^A and 2^B).

Now, in the 11 cm. stage there was as described a considerable development of fibrous connective tissue, both on the ventral and dorsal free surfaces of the lung (fig. 2^A, **'); and the idea naturally suggests itself that, as far as that part of the lung which lies in the region of the liver is concerned, the fibrous tissue ventral to the lung [working backwards and forwards from the points opposite the anterior and posterior ends of the liver (*cf.* figs. 1^A and 3^A), where we saw the lung in the 11 cm. stage excluded from the peritoneal cavity] has formed a "diaphragm," similar in its relation to the lung, though perhaps not otherwise homologous, to the "diaphragm" of Birds; and that almost synchronously the fibrous tissue dorsad of the lung (fig. 2^A, *') has obliterated the pleural cavity, thus produced, as the pleural cavity *is* obliterated in Birds.

But of course, in the absence of an intermediate stage, one cannot be absolutely certain of what happens; and it is possible that the changes which have taken place may be in part comparable to those which lead to the formation of the "diaphragm" in Mammals. With regard to the other divisions of the body-cavity, the left half of the liver now lies in a closed sac (*the left liver-sac*) (fig. 2^B, *P.l-liver-sac*). The closing of this sac has resulted, firstly from an extension backwards of that obliteration of the peritoneal space on the left of the œsophagus which was seen taking place in the previous stage, and secondly from the connection with the lateral body-wall of the fibrous posthepatic septum, which was also seen forming out of the ventral ligament of the stomach.

The liver-sac of the right side (fig. 2^B, P^l) is still continuous, by a long and very narrow peritoneal tubule (fig. 3^B, P^o), with the main posterior peritoneal space.

Following this narrow tube backwards from the liver-sac, we find that it runs externally to (on the right side of) the postcaval and vitelline (or portal) veins, and that it contains a minute forward continuation of the funnel of the oviduct, represented by a raised groove on the wall of this small space. As this tube of communication is now so small, and has no apparent use, it is not surprising that it should be obliterated in the adult.

In the figure (3^B) we see, cut through, a very small cavity, on the right side of the stomach, in the corner between it and the lung. This must be the remains of the "*omental space*," as to the persistence of which in the adult of this species I am not certain (see list).

Lastly, as to the *gastric space*. This is also seen in section in fig. 3^B (P^g). Following the sections backwards, we find that it is still freely continuous with the posterior portion of the peritoneal cavity.

Finally, at this stage, sections through the region of the pancreas show that the ventral ligamentous attachment of the alimentary canal to the adjacent body-wall becomes here very broad; so that we can easily understand how, when the alimentary canal comes to be bent and folded on itself, as it here does later on, the *gastric* sac might become closed posteriorly, in somewhat the same way as did the left liver-sac. The permanent kidneys (which in the preceding stage were only just making their appearance, and then had the peritoneum extending as a backwardly directed pocket external to each and covering their mesial surface) are now fairly developed, and it is found that the posterior part of each lies completely outside the body-cavity. In the adult they come to lie entirely outside it.

§ VII. *The Subdivisions of the Body-cavity in Snakes compared with those in other Sauropsida.*

[I here refer to the figures illustrating my previous paper (5).]

(i.) The *posterior peritoneal space* seems to have its exact homologue in Crocodiles [(5) figs. 42, and 43, 3], and it is very similar to the posthepatic cavity in the Lizard *Tupinambis* [(5) fig. 31, 3] or a Bird [(5) figs. 14–18, 3); but in the Bird there is on the left side and in *Tupinambis* on both sides [(5) fig. 32, *o*, *o'*] a connection with the anterior part of the body-cavity. In fact:—

(ii.) Snakes agree with Birds (e. g. *Gallus*, *Anas*), Crocodiles, and the Lizard *Tupinambis* in having a septum across the body-cavity behind the liver (*posthepatic septum*). In Birds and *Tupinambis* this septum is incomplete.

(iii.) The *gastric space* seems to have an almost exact homologue in Crocodiles [*cf.* (5) figs. 42 and 43, in which a small unpaired space is seen in the region of the stomach [1]].

(iv.) The *omental space* is, as described above [§ IV. (iv.) note], well represented in all the other groups of Sauropsida.

(v.) As to the *liver-sacs*, the task of comparison is not so simple. The ventral liver-sacs of Crocodiles are no more comparable with those of Snakes than with those of Birds. We also soon see that there is a considerable difference between the body-cavity in the pulmohepatic region of Snakes and that in the corresponding region of the Bird. Thus, if we start from the median ventral ligament of the liver and proceed outwards, we find in the case of the Fowl [(5) fig. 45] that the spaces 1, 1 are bounded laterally by the body-wall, or rather by the "oblique septum"; but in Snakes (fig. 3^B) we pass all round the liver and reach the median dorsal attachment of that organ. This difference is clearly correlated with the fact that while in Snakes the "pulmohepatic recesses" are totally or almost totally absent [see above, § VI. (i.)], in Birds they are remarkably well developed [(5) fig. 45, 2, 2′].

In short, the "avian diaphragm" is developed out of fibrous tissue on the ventro-mesial face of the lungs, which tissue bounds these spaces (2, 2′) externally. But while the fibrous tissue, which forms a sort of diaphragm ventral to the lung in Snakes, and bounds the right liver-sac dorsally, appears to have a somewhat similar relation to the lung, its other relations are different. In fact, but for its adherence to the lung, one might, from its topographical relations, rather compare the diaphragmatic tissue in Snakes with that in Mammals.

It would seem hardly more possible to closely homologize the "diaphragm" and liver-sacs of Snakes with those of Birds than the diaphragm of Mammals with that of Birds. In the case of animals which have descended from common ancestors along more or less divergent lines, we ought not of course to expect to be always able to compare *directly* corresponding parts, but rather to have to content ourselves sometimes with tracing the condition of things in each back to their common origin.

It may be remarked that the lungs of *Varanus* (*Monitor*) are excluded from the peritoneal cavity by a sort of "membranous diaphragm" [2], and this is less markedly the case with the lungs of certain Chelonia. It may well be, therefore, that the relations of the lung in Snakes can be explained by a reference to one or both of these groups; but this embryology alone can decide.

[1] It is marked in these figures with a number 1, like the paired ventral liver-sacs, because I was led to regard both the ventral part of the posthepatic septum (β) which closes the liver-sacs posteriorly, and the fibrous tissue (β) which closes this gastric sac posteriorly, as but lateral expansions of the median ventral attachment of the stomach and liver, from which point of view the sac in the region of the stomach and the paired ventral liver-sacs might be grouped together. The embryology of Snakes seems to be in favour of the essential similarity between the septa $\beta\beta$ (*see* § VI.); but as in Snakes this gastric space is so distinctly posterior to the two liver-sacs, it may with advantage be considered apart from them in both those animals and Crocodiles.

[2] Martin, P. Z. S. 1831, p. 138. See also P. Z. S. 1889, p. 608.

(vi.) Besides the definite subdivision of the body-cavity described above, there are found in Snakes a number of modifications which tend to obliterate the pleuroperitoneal cavity.

Consideration, however, shows us that these modifications of the simple primitive condition (like those which lead to the definite subdivision of the body-cavity) take place along lines which are followed to a greater or less extent in other groups of Sauropsida. And Snakes differ in this respect, to some extent, among themselves.

Thus, the obliteration of the pleural cavity may be compared with what we find in Birds (and possibly also in Monitor Lizards, if not in Chelonia).

Again, the complete exclusion of the kidneys from the body-cavity, although the rule with the Snakes, is, we see, not confined to this order. A partial exclusion is rather usual [*ante* § IV. (i.) and notes.]

Thirdly, the remarkable development of extra-peritoneal lymph-cavities in Snakes, which still further reduces the space available for the body-cavity proper—is but an exaggeration of what we find in other Reptiles (e. g. *Monitor* and Amphisbænidæ) [*ante* § IV. (0)].

Lastly, the relation of the alimentary canal to the peritoneum, so often described, certainly does appear to be a peculiarity of Snakes; concerning this, Snakes differ among themselves, some departing less than others from the common type (in which the intestine hangs by a mesentery into the peritoneal cavity). The firm attachment of the stomach in Crocodiles seems essentially similiar to that in Snakes.

§ VIII. *Conclusions.*

(1) In Snakes, as in Crocodiles, the pleuroperitoneal cavity is, for great part of their embryonic period, very similar to that of adult Lizards; and the same is true of the earlier stages of Birds and Mammals.

(2) In Snakes the simple, primitive, lacertilian condition becomes during the later stages of development modified, in the following ways:—

(*a*) The pleural part of the body-cavity becomes obliterated.
(*b*) The peritoneal part of the body-cavity becomes subdivided into a definite number of closed spaces, viz.:
(i.) A posterior, or intestino-genital space.
(ii.) A gastric space on the left side.
(iii.) An "omental" space.
(iv.) Two paired liver-sacs.

(3) An examination of representatives of nearly all types of Snake (see list) shows that however much they may differ, in actual size, in the proportion of their parts, in various anatomical characters, and in their habit of life, they all agree in the plan on which their peritoneal cavity is subdivided.

(4) The subdivision of the body-cavity of Snakes proceeds in

large measure along lines followed in effecting a similar subdivision in other groups of Sauropsida. Thus:—

(i.) The *omental space* corresponds in all Sauropsida and it is a closed space, as in Snakes, in at any rate certain Birds, Crocodiles, and Chelonians.

(ii.) We may find in Sauropsida either a complete (Snakes, Crocodiles) or partial (Birds and *Tupinambis*) *posthepatic septum* across the body-cavity behind the liver.

(iii.) In Crocodiles, as well as in Snakes, we get the left, anterior, portion of the posthepatic peritoneal cavity shut off as a *gastric* space, leaving the remainder as a closed *intestino-genital* space.

As to each of the above-mentioned points, then, there seems to be a fairly close homology between Snakes and one or more of the other groups of Sauropsida.

(5) On the other hand, while there are points about the obliteration of the pleural cavity and the relations of the liver-sacs in Snakes which remind us of what occurs in Birds, there is perhaps no closer similarity in these respects between the two groups than between the "diaphragm" of Mammals and that of Birds.

§ IX.—EXPLANATION OF PLATE XXVIII.

ao.	Dorsal aorta.
cist. mag.	Cisterna magna.
c.w.	Wolffian body.
f.	Developing fat-body projecting into circumadiposal lymph-space.
g.bl.	Gall-bladder.
œsoph.	Œsophagus.
P	Signifies a part of the pleuroperitoneal cavity, thus:—
P^g	That part of peritoneal cavity which later forms the closed *gastric* space.
P^l	That part which will form a *liver-sac*.
P.l-liver-sac	Is the already closed left liver-sac.
P^p	The pleural part of pleuroperitoneal cavity—destined to be obliterated.
P^o (in fig. 3)	Narrow peritoneal tube connecting the right liver-sac and the posterior peritoneal cavity—destined to be obliterated.
Umb.	Umbilical stalk.
v.a.	Allantoic, or anterior abdominal vein.
v.c.p.	Vena cava posterior.
v.vp.	Vitelline-portal vein.
**'	Connective tissue on free surface of lung.

Fig. A. Embryo (♂) of *Elaphis quadrilineatus*, 11 cm. long. Nat. size. Outline sketch, to show the relations and proportional development of the lung, liver, and other parts indicated. [The embryos were curled round in the eggs, and at this stage it would probably not be possible to straighten one to this degree. This is a rectified sketch of a partially straightened embryo.]

Fig. B. Embryo (♀) of *Elaphis quadrilineatus*, 15 cm. long. Nat. size. Outline sketch of an artificially straightened embryo for comparison with A.

Fig. 1[A]. Transverse section of *Elaphis* embryo, of the same size as fig. A, through the ventricle of the heart (×14).

Fig. 2^A. Transverse section of same embryo, through anterior part of liver ($\times 14$).
Fig. 3^A. Transverse section of same embryo, through the gall-bladder ($\times 14$).
Fig. 2^B. Transverse section of embryo of same stage as fig. B, through a region as nearly as may be corresponding to that in fig. 2^A ($\times 14$).
Fig. 3^B. Transverse section of same embryo, through a region as nearly as may be corresponding to that in fig. 3^A ($\times 14$).

2. On a Collection of Birds from the Island of Anguilla, West Indies. By P. L. Sclater, M.A., Ph.D., F.R.S., Secretary to the Society.

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Mr. W. R. Elliott, one of the Collectors employed by the Committee of the Royal Society and British Association for the exploration of the Lesser Antilles, paid a short visit to Anguilla [1] in March last, and made a small collection of birds, which I have now the pleasure of exhibiting. It contains 27 skins, which are referable to 16 species. There is nothing new or even rare amongst them, but as, so far as I know, no ornithological collector has previously been in Anguilla, and its Ornis is entirely unknown, it will be of interest to record the names of the species represented in the Collection and to add a few remarks.

Besides the species now mentioned Mr. Elliott writes that two other birds were seen—a "Chicken-hawk" (perhaps *Falco columbarius*) and a Bittern (probably *Butorides virescens*). The former was common, but the latter "rather scarce at this time of year."

Mr. Elliott was told that during the wet season a large number of other birds visit the island. When he was there in March, every thing was burned up by a three months' drought. The birds obtained are therefore "undoubtedly permanent inhabitants." Amongst the visitors during rainy season he hears of "plovers, ducks, and snipes in large flocks."

In the following list I have given references to Mr. Cory's most useful 'Birds of the West Indies' (Boston, 1889), in which all the species are mentioned.

+1. Margarops fuscatus (Vieill.).

Cichlerminia fuscata, Sharpe, Cat. B. vi. p. 329.
Margarops fuscatus, Cory, B. of W. I. p. 28.

A single male specimen. "*Thrush*, scarce now, but as a rule common; seems to have left the island in search of food."—W. R. E.

[1] "Anguilla, or Snake Island, the most northerly of the British Caribbee Islands, lies north of St. Martin's, from which it is distant about 5 miles. It is about 20 miles long and 6 broad, but is so low and flat that it cannot be seen from a greater distance than 10 or 12 miles. The soil is calcareous and not very productive. A little sugar, cotton, tobacco, and maize are grown on it, but it is deficient both in wood and water. In the centre of the island is a saline lake which yields a large quantity of salt, the greater part of which is exported to America. The climate is healthy. The chief occupations of the inhabitants are breeding cattle and gathering salt."—*Imp. Gazetteer*, i. p. 158.

—2. Dendrœca ruficapilla (Gm.).
Dendrœca ruficapilla, Sharpe, Cat. B. x. p. 275.
Dendrœca petechia ruficapilla, Cory, B. W. I. p. 45.
A pair. "*Yellow Finch*, common."

—3. Certhiola bartolemica (Sparrm.).
Certhiola bartolemica, Scl. Cat. B. xi. p. 42; Cory, B. W. I. p. 64.
A pair. "*Yellow-breast*, fairly common."
This form is probably the same as that of the neighbouring island of St. Bartholomew, but there are no specimens available for comparison.

—4. Loxigilla noctis (Linn.).
Loxigilla noctis, Sharpe, Cat. B. xii. p. 84; Cory, B. W. I. p. 91.
A pair of this species. "*Red-breasted Sparrow*, very scarce at this time of year."

—5. Phonipara bicolor (Linn.).
Phonipara bicolor, Sharpe, Cat. B. xii. p. 149.
Euetheia bicolor, Cory, B. W. I. p. 96.
One ex. ♂. "*Green Sparrow*, fairly common."

+6. Elainea martinica (Linn.).
Elainea martinica, Scl. Cat. B. xiv. p. 141; Cory, B. W. I. p. 117.
Two males. "*Whistler*, scarce."

+7. Tyrannus rostratus, Scl.
Tyrannus rostratus, Scl. Cat. B. xiv. p. 273; Cory, B. W. I. p. 129.
Two males and a female. "*Chincherry*, common."

+8. Eulampis holosericeus (Linn.).
Eulampis holosericeus, Cory, B. W. I. p. 146.
One male. "*Humming-bird*, fairly common."

+9. Orthorhynchus exilis (Gm.).
One female. "*Humming-bird*, fairly common."

+10. Tinnunculus caribbæarum (Gm.).
Tinnunculus caribbæarum, Gurney, List of B. of Prey, p. 99.
Falco caribbæarum, Cory, B. W. I. p. 204.
A pair. "*Killy-killy*, common."

+11. Zenaida martinicana, Bp.
Zenaida martinicana, Cory, B. W. I. p. 215.
A female. "*Turtle-dove*, scarce now, said to be common in the rainy season."

12. Chamæpelia passerina (Linn.).

Columbigallina passerina, Cory, B. W. I. p. 217.

A pair. "*Ground-dove*, common."

13. Gallinula galeata (Licht.).

Gallinula galeata, Cory, B. W. I. p. 257.

A pair. "*Coot*, common near brackish ponds."

14. Strepsilas interpres (Linn.).

Arenaria interpres, Cory, B. W. I. p. 231.

A female, in immature plumage. "Very rarely seen—in fact never observed before. The Rev. Mr. Schouten, who takes great interest in Natural History, and has resided in Anguilla twenty-eight years, told me it was quite new to him."—W. R. E.

15. Totanus flavipes (Gm.).

Totanus flavipes, Cory, B. W. I. p. 238.

Two females. "*Yellow-legs*, common near brackish ponds.'

16. Phaëthon æthereus, Linn.

Phaëthon æthereus, Cory, B. W. I. p. 275.

Two males. "*Tropic-bird*: nests in holes among the cliffs on the sea-side."

3. On the Insectivorous Genus *Echinops*, Martin, with Notes on the Dentition of the allied Genera. By Oldfield Thomas.

[Received June 3, 1892.]

At the Meeting of this Society on Feb. 13, 1838[1], Mr. W. Martin exhibited and described an Insectivore belonging to the group known as "Madagascar hedgehogs," but much smaller than the common *Ericulus setosus*, and gave it the new generic and specific name of *Echinops telfairi*, in honour of its donor, Mr. C. Telfair. A fuller description, with accurate figures both of the animal and its skull, was given by the same naturalist a little later[2], and from these it might have been easily seen that the animal was fully adult. This specimen has remained unique almost up to the present time[3], and on this account, the species not being known, the name *Ericulus telfairi* has been of late years wrongly assigned to *Ericulus setosus*.

The genus *Echinops* was properly recognized by Wagner[4] (who

[1] P. Z. S. 1838, p. 17.

[2] Trans. Z. S. ii. p. 249, pl. 46 (1840).

[3] The young individual, 17 days old, also sent by Mr. Telfair, and mentioned P. Z. S. 1833, p. 81, proves on examination to be the ordinary larger form *Ericulus setosus*.

[4] Schreb. Säug. Suppl. ii. p. 29 (1840).

unnecessarily renamed it *Echinogale*), by Peters[1], by Mivart[2], and by Grandidier[3]; but unfortunately Dr. Jentink, in an exhaustive and otherwise most useful paper on the group, deceived by the small size of the type, put it down[4] as a young specimen of *Ericulus setosus*, an example followed by Trouessart[5] and Dobson[6]. The latter no doubt overlooked the type now in the British Museum, and the two former had not of course the opportunity of examining it.

Of this type specimen the cranium, figured by Mr. Martin, was unfortunately lost before the Museum of the Zoological Society was transferred to the British Museum, but the skin, the lower jaw, and the bones of the trunk are still preserved. These confirm in every way the accuracy of Mr. Martin's description and figures.

The Museum has now received several specimens of this group collected by Mr. J. T. Last at Manumbu, S. Madagascar, which clearly belong to two different species, a larger and a smaller, also differing from one another by the number of their teeth.

The former of these is clearly *Ericulus setosus*, and the latter is by its dentition an *Echinops*, a genus which I now propose to reinstate, but on the description of which by Martin and Mivart I shall not try to improve, except with regard to the homologies of its cheek-teeth, which will be referred to later. It may, however, be noted that, apart from the general size, not always easily determinable in these animals, the two forms may be readily distinguished externally by the great difference in the size of the claws, those of *Ericulus* attaining a length in front of about 6 mm., and behind of about 7 mm., while those of *Echinops* scarcely exceed 3 in front and 4 behind, with a proportionate reduction in thickness.

As to the species to which Mr. Last's *Echinops* belongs I am more doubtful. Firstly, it appears to be smaller than *E. telfairi*, and to have smaller teeth, but the difference is very slight. Secondly, the type of the older known species has the spines all quite black-tipped and becoming gradually paler to the roots. On the other hand, Mr. Last's specimens, four in number, all have white-tipped spines, the white extending over the terminal 2 or $2\frac{1}{2}$ mm. of the spine[7]. In view of the great variability of *Ericulus setosus* in the colour of the spines, this character must be looked upon with great hesitation; but at the same time the difference in appearance is so very great that I think it should be recognized by name, and I propose to call Mr. Last's *Echinops* a new subspecies, giving it the name of *E. telfairi pallescens*.

The following are the measurements of the typical skull of the new form, the largest of five:—

Basal length 34·1; greatest breadth (between points of maxillary

[1] MB. Ak. Berl. 1865, p. 286.

[2] P. Z. S. 1871, p. 73.

[3] Rev. Mag. Zool. (2) xxi. p. 338 (1869).

[4] N. L. M. i. p. 140 (1879).

[5] Le Nat. 1880, p. 178.

[6] Mon. Insectiv. p. 70 (1882).

[7] M. Grandidier (*l. c.*) describes as "*E. mivarti*" an animal which is "noirâtre et plus foncé que *E. telfairi*"; but the latter being superficially quite black, it is probable that he has mistaken the form to which the name *E. telfairi* belongs, and that his *mivarti* is really *telfairi*, and his *telfairi* the one now described.

zygomatic processes) 16·7; interorbital breadth 9·1; palate, length 19·1, breadth outside $\underline{p^4}$ 12·2, inside $\underline{p^4}$ 4·7; length of lower jaw from condyle (bone only) 27; height from coronoid to angle 13·4.

Of the five specimens examined, two others are of almost precisely the same size as the type, and two, of similar age, are rather smaller, the difference being, I presume, sexual. Unfortunately the skins and skulls are not identified with each other, so that I cannot say for certain whether in this form the male or the female is the larger.

Now with regard to the homologies of the teeth of *Echinops*, the five cheek-teeth of which have been supposed to be two premolars and three molars, the reduction from the 3–3 of *Ericulus* being therefore in the premolars,—I find on comparison that this is not the case, but that the reduction is in the molars, of which there are only two, while the premolars number three. These three premolars all have milk predecessors, as is also the case in *Centetes* and *Ericulus*, and therefore the missing premolar of the full set of four may be presumed to be p^1, which is as yet not known to change in any member of the Linnean group of Feræ. The incisors are two, above and below, both in the permanent and milk series.

The full dental formula of *Echinops* is therefore

$$\text{I.}\left\{\begin{array}{ccc}1&2&0\\ \scriptstyle 1&\scriptstyle 2&\\ \hline \scriptstyle 1&\scriptstyle 2&\\ 1&2&0\end{array}\right.\quad \text{C.}\left\{\begin{array}{c}1\\ \scriptstyle 1\\ \hline \scriptstyle 1\\ 1\end{array}\right.\quad \text{P.}\left\{\begin{array}{cccc}0&2&3&4\\ &\scriptstyle 2&\scriptstyle 3&\scriptstyle 4\\ \hline &\scriptstyle 2&\scriptstyle 3&\scriptstyle 4\\ 0&2&3&4\end{array}\right.\quad \text{M.}\left\{\begin{array}{cc}1&2\\ \hline 1&2\end{array}\right\} = 24.\,32^{1}.$$

Comparing this with the formulæ of some of the allied genera, we find that *Ericulus* is in all respects the same except that it has M. $\frac{1.2.3}{1.2.3}$, the totals therefore being 24. 36.

Two points about the milk-change of *Ericulus* may be specially noticed, both of them showing a very low and unspecialized condition. The first is the extraordinary resemblance existing between the milk-teeth and their respective successors, a resemblance so great that it is extremely difficult to say whether any given set of teeth belongs to the milk or permanent series. And this difficulty is increased by the second point, namely the fact that the molars come up with and stand perfectly in series with the milk premolars, the last molar being fully up and in use some time before these commence to fall. This fact, in so lowly an animal, is decidedly confirmatory of the recent suggestion that the molars even of the Placentals really belong to the milk rather than to the permanent series[2].

[1] This ingenious method of so writing the dental formulæ as to show clearly both the milk and permanent teeth and their relations to one another is copied from Dr. Winge's paper "Om Pattedyrenes Tandskifte" (Vid. Medd. 1882, p. 15). The method is so clear that no explanation is needed.

[2] *Cf.* (for Marsupials) Kükenthal, Anat. Anz. vi. pp. 369 & 658 (1891), and (for Placentals) Thomas, Ann. Mag. N. H. (6) ix. p. 310 (1892).

Passing now to the dentition of *Centetes*[1], besides the known increase by one each in the number of the upper milk and the lower milk and permanent incisors, we find a most remarkable and noteworthy character in the number of the molars.

When writing his invaluable Monograph of the Insectivora, Dr. Dobson stated[2] *en passant*, and merely as a question of specific difference or identity, that certain specimens of *Centetes ecaudatus* in the British Museum were much larger than usual, and had an additional upper molar. Now remembering the continual and unending discussion that the presence of four true molars in *Otocyon* has given rise to, it is evident that the occurrence of a fourth upper molar in *Centetes* is an exceedingly interesting fact, and one that deserves to be brought into much greater prominence.

A renewed examination of the specimens shows that the presence of four molars is not a merely accidental variation in one or two individuals, *but is a normal character of the species*, although the fourth molar only comes up very late in life—so late, in fact, that the great majority of Museum specimens do not possess it. This is proved by my finding the minute calcified germ of $\underline{\mathrm{m}}^4$ behind the $\underline{\mathrm{m}}^3$ of what is, apart from the three unusually large individuals referred to by Dobson, the largest skull in the Museum collection, and one that, in the absence of these three, would have been put down as a remarkably fine and well-grown one. Judging, therefore, by the specimens in the Museum, it appears probable that the species seldom attains to the great age necessary to obtain the fourth molar, but that when it does, it normally has the additional tooth.

Curiously, however, not only is m^4, like our own "wisdom tooth," long behind m^3 in its date of appearance, but owing to the fact that it projects further into the mouth and is rather feebly attached, it is the *first* of the molars to disappear. For in one extremely aged specimen, in which the molars and premolars are worn down to the roots[3], $\underline{\mathrm{m}}^4$ has again entirely disappeared, and has evidently been worn down and dropped out in the natural course of existence.

[1] Thanks to the kindness of Prof. A. Milne-Edwards, who has sent me a complete copy of the chapter referring to the Tanrecs in Geoffroy's rare 'Catalogue du Musée,' I am most fortunately able to state that the name *Setiger*, Geoffr. (1803), need not displace *Centetes*, Ill. (1811), a change which appeared to be imperative on reading Trouessart's paper, already quoted.

In this paper, while stating that *Setiger* was absolutely synonymous with *Centetes*, the author exercised in favour of the latter that fancied right of selection which has been so disastrous throughout the history of zoological nomenclature. However, the copy now before me of Geoffroy's words shows that the typical and first mentioned species of his genus "*Setiger*" is "*S. inauris*," whose characters are largely mixed up in the generic diagnosis; and this animal, as we know from p. 22 of Isidore Geoffroy's paper on the group (Guérin, Mag. Zool. Mamm. (2) 1839, Art. 1), was neither more nor less than a common Hedgehog which had lost its ears. This being the case, *Setiger* becomes a synonym of *Erinaceus*, Linn., and happily remains in its time-honoured obscurity.

[2] Mon. Insectiv. p. 69, pl. vii. fig. 7.

[3] This specimen presents an example of that mechanical wearing down, and consequent increase in the number of "teeth," on which Dr. Kükenthal in the case of a Seal has laid such stress (*t. c.* p. 367); for its p^2 has formed two, and its p^3 three minute "teeth," these being of course merely the roots of the proper teeth (see my own remarks, *t. c.* p. 311).

None of the specimens show any trace of a lower m^4.

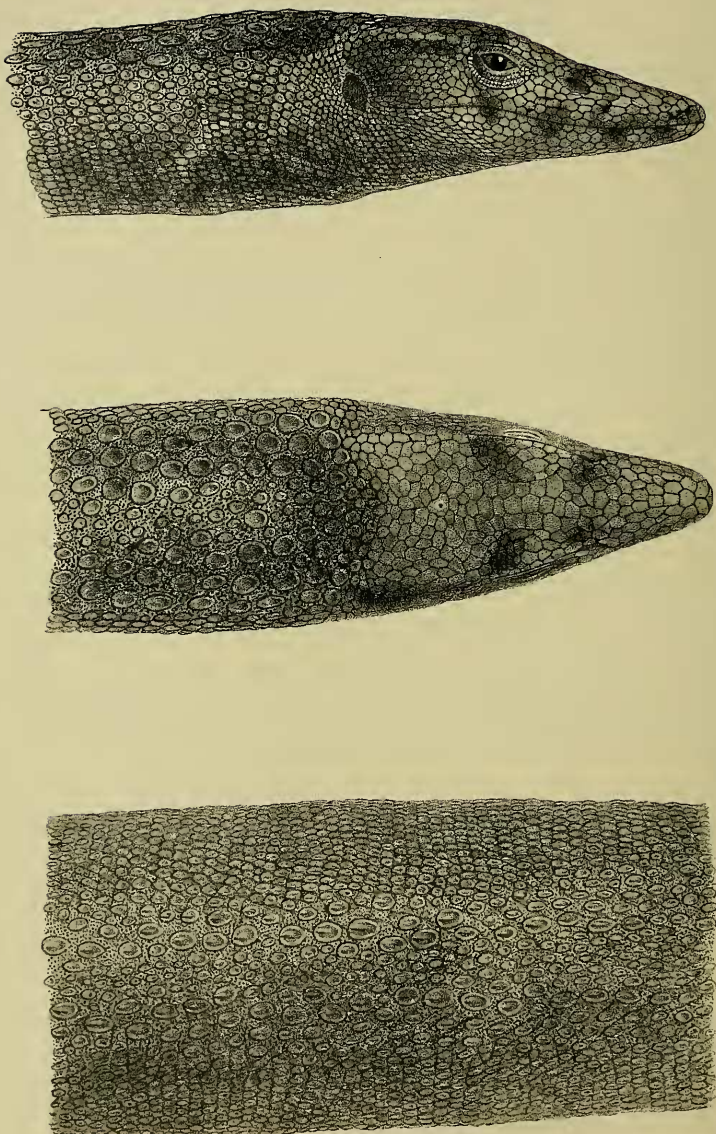
In these three genera of *Centetidæ* and, so far as I can make out from the published figures, in *Potamogale*, we have a premolar formula of $\left\{\begin{matrix}0 & 2 & 3 & 4\\ & 2 & 3 & 4\end{matrix}\right.$; the p^4 (both milk and permanent) is absolutely molariform, while p^3 (again both milk and permanent) is functionally a "carnassial"—characters all in contrast to those of *Solenodon,* on whose close relationship to the *Centetidæ* so much has been written.

In this animal there are, it is true, three premolars as in *Centetes* and the others, but of these *the first does not change,* a fact which seems to show that it is homologous with the non-changing p^1 of other Feræ, and not with the changing p^2. If this be the case, and the two posterior changing premolars be still looked upon as p^3 and p^4, we get the formula P. $\left\{\begin{matrix}1 & 0 & 3 & 4\\ & & 3 & 4\end{matrix}\right.$, while as a further difference p^3 is absolutely premolariform, and it is p^4 that is functionally "carnassial" or semi-molariform, no premolar being truly molariform; and finally there is neither that striking resemblance between the milk and permanent teeth, nor the unusually early development of the true molars, characteristic of the *Centetidæ*.

It appears to me therefore that not only was Dr. Dobson perfectly justified in separating the *Solenodontidæ* as a distinct family from the *Centetidæ,* with which Peters had placed them, but I would go further and suggest that their main connecting link—their common trituberculism—may be merely in each case a remnant of a time when, as the American zoologists have shown, trituberculism was a far more common character than at present, and that they have really no very close relationship to each other whatever. The proper solution of this problem will probably rest with the palæontologists of North America, on which continent the ancestors of *Solenodon* may be expected to have lived; and in consideration of its great general and geographical interest, I would specially commend it to the notice of any of them who may have the opportunity of examining remains referable to early Insectivora.

The following is a tabular arrangement of the formulæ above described, with the addition of that of *Gymnura,* put in for comparison with the rest. Numbers in italics represent teeth which, although present, are minute and apparently functionless. No definite suggestions as to the serial homologies of p^1 or of the molars are intended to be conveyed by the type in which their respective numbers are printed.

	I.	C.	P.	M.
Centetes . . .	1 2 0	1	0 2 3 4	1 2 3 4
	1 2 3	1	2 3 4	
	1 2 3	1	2 3 4	
	1 2 3	1	0 2 3 4	1 2 3
Ericulus . .	1 2 0	1	0 2 3 4	1 2 3
	1 2 0	1	2 3 4	
	1 2 0	1	2 3 4	
	1 2 0	1	0 2 3 4	1 2 3



Peter Smit del. et lith.

Mintern Bros. imp.

VARANUS. HETEROPHOLIS.